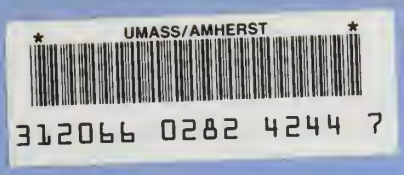
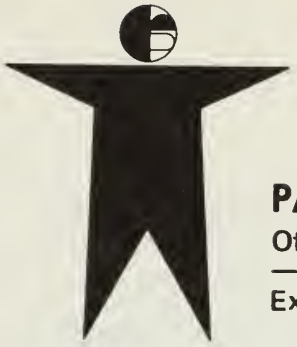


STANDARDS AND GUIDELINES, ACUTE INPATIENT SERVICES

June, 1973

Massachusetts Office of Comprehensive Health Planning



PARTNERSHIP FOR HEALTH IN MASSACHUSETTS
Office of Comprehensive Health Planning

Executive Office of Human Services

STANDARDS AND GUIDELINES, ACUTE INPATIENT SERVICES

JUNE, 1973

COMMONWEALTH OF MASSACHUSETTS
OFFICE OF COMPREHENSIVE HEALTH PLANNING
ROOM 909, LEVERETT SALTONSTALL BUILDING
100 CAMBRIDGE STREET, BOSTON, MASSACHUSETTS 02202

Publication of this document was financed in part through a grant from the U.S. Department of Health, Education and Welfare under P.L. 89-749, the "Partnership for Health" Act.

Publication of this Document Approved by Alfred C. Holland, State Purchasing Agent.

400-8-73-082891

Est. Cost Per Copy: $1.44

CONTENTS

ACKNOWLEDGEMENTS

In the process of preparing "Standards and Guidelines, Acute Inpatient Services," the staff of the Office of Comprehensive Health Planning read literally hundreds of articles and studies, and spoke with scores of individuals. Without the assistance of these many people, whose ideas, experience, knowledge, and prior work gave us a base on which to build, "Standards and Guidelines" would not have been possible. To list them all would be impossible, but we express our grateful appreciation.

A special word of thanks is extended to our partners in this and related projects within Massachusetts State Government in the Executive Office of Human Services, Department of Public Health, and the Rate Setting Commission. Their willingness to share thoughts and information, and offer comments and suggestions, especially during the preparation of the final drafts of the report, has been most helpful.

Finally, I would like to express my personal thanks to the members of the Long Range Planning and Standards Committee who have over the past months given generously of their time and efforts in a most dedicated fashion, studying hundreds of pages of reports, counseling me and the OCHP staff in steps to take, and, in a most skillful and knowledgeable way, shaping "Standards and Guidelines" as well as other "LRPS" projects. These most esteemed colleagues are Dr. Federico Welsch, Dr. Thomas Gephart, Frank Foster, Dr. George Grosser, John Lund, Adam Yarmolinsky, Richard Tompkins, Dr. Joseph Kelly, and Paul Poulos.

Fred G. Lehmann
Chairman, Long Range
Planning and Standards
Committee; Advisory
Council to the Office
of Comprehensive Health
Planning

INTRODUCTION TO STANDARDS AND GUIDELINES FOR ACUTE INPATIENT SERVICES

The Massachusetts Office of Comprehensive Health Planning (OCHP) is currently completing work on Volume I of the Massachusetts Comprehensive Health Plan. One section of the Plan will deal with Resource Allocation and Costs. Our first objective in completing this section of the Plan is the development of qualitative and quantitative standards for the design and distribution of acute inpatient services. This paper addresses that subject.

Standards, in this context, may be understood to be guidelines or criteria to be used in the decision making process. The Standards outlined in this paper were derived after exhaustive research and review of well over five hundred books, articles and studies. More than sixty different standards were examined as well as statistics from fifty sources. Principal factors considered in proposing the standards were economies of size, quality of service, breadth of service and accessibility.

Commitment to use such standards could bring about significant changes in the health care system in Massachusetts. For example, at present the number of short-term inpatient medical/surgical, pediatric, and maternity beds in the state is 4.4 beds per 1,000 population. If Massachusetts were to reduce its bed level to 4.0 per 1,000 population, as is suggested by standard #8 in this paper, the result would be a savings of seventy million dollars yearly.

Although a slight amount of these savings within the acute inpatient hospital sector would be offset by an additional resource requirement in the long term care area, most of these "free funds" could be programmed in a variety of ways, such as toward the establishment of needed ambulatory care centers. We know that implementation of these standards would bring about changes that could significantly affect the structure of the health care system over a period of years.

The OCHP Advisory Council adopted the standards on June 26, 1973 and directed its Long Range Planning and Standards Committee (LRPS) to continue evaluation of the standards with interested parties as to the appropriateness of the numerical values used. The Council asked the LRPS Committee to report by July 1, 1974 on progress made towards implementing the standards. The standards will be incorporated into Part III of the Massachusetts Comprehensive Health Plan, "Resource Allocation and Cost."

The OCHP staff and the LRPS Committee encourage comments to aid in their continuous reevaluation of the standards.

STANDARDS, ACUTE INPATIENT SERVICES

1. That the minimum size of a hospital in an urban area[1] be 200-300 beds, and that the minimum size of hospitals in non-urban areas be 100 beds. (pp. 16-23; App. A)

   a. that these minimum sizes apply in all instances where the inpatient census within a service area[2] readiliy translates into the requirement for short-term inpatient bed needs in excess of these minimums.

   b. that these minimum size requirements may be waived in those instances dictated by relative geographic isolation of the population and/or by the requirements of an emergency medical service system.

2. That the minimum number of short-term pediatric beds within a hospital be 20 and that the absolute minimum number of pediatric beds within a unit be 10 beds. (pp. 16-23; App. A)

   a. that if the patient census cannot support a minimum size pediatric unit of 10 beds, that a sufficient number of beds be reserved which have a versatile use.

   b. that the existence, within the same service area, of two or more pediatric units any of which do not conform to the minimum standards be considered de facto evidence for closing or merging the non-conforming unit(s).

   c. that the existence, within the same service area, of two or more pediatric units of any size be considered rightfully subject to review for merger or consolidation.

3. That the minimum number of deliveries performed in a maternity service be 1500-2000 per annum. (pp. 16-23; App. A)

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[1] "For purposes of this report, 'urban area' refers to areas included in a Standard Metropolitan Statistical Area; 'non-urban areas' refers to areas not included in a Standard Metropolitan Area."

[2] "'Service area' is not defined in this report due to the complexity of formulating a definition applicable to hospitals of varying size, scope and type of services offered, and population base from which patients are drawn. At this time prime indicators of service area are considered to be travel time to the hospital, patient origin data, and designation of service areas by Regional Health Planning Councils in conjunction with the hospitals themselves."

a. that this requirement on the minimum number of deliveries be waived in those instances dictated by relative geographic isolation of the population.

b. that this minimum requirement apply in all instances where the number of deliveries from within a service area is in excess of the minimum.

4. That the beds assigned to an obstetric service should be allowed to be used for gynecologic patients deemed suitable by the medical staff of a hospital and in conformance with any existing laws, rules, or regulations. (pp. 13 and 14)

5. That the minimal occupancy rate (annual) for computing the need for inpatient beds by service or assessing the operations of existing services be: (pp. 40 and 41; App. C)

Service Size	Minimal Occupancy Rate
Medical/Surgical	
50-100 beds	75-80%
100-200 beds	80-85%
200 + beds	85-90%
Obstetric	
10-15 beds	50-65%
15-20 beds	60-70%
20-50 beds	65-75%
50 + beds	75-85%
Pediatric	
10-20 beds	60-65%
20-40 beds	65-75%
40-80 beds	70-85%
80 + beds	75-85%

6. That hospitals within a planning region develop formal associations with each other, chronic disease hospitals, extended care facilities, and home service organizations. (pp. 66-75; App. A pp. 6 and 7)

a. that the planning and development of any specialized services within a hospital be done in cooperation with all other hospitals within a planning region to assure appropriate and economical existence of such services.

b. that the development of formal associations among institutions and organizations allow for a physician who refers a patient from one institution or organization to another to have consulting privileges on his case.

c. that the physician or physicians in charge of any patient should use the most appropriate institution or organization for the care of the patient; and if the physician or physcians in charge of any patient who requires continuing supervision by a physician cannot continue their responsibility for the care of a patient, then the responsibility for the care of the patient must be formally designated to another physician.

d. that physicians be encouraged to develop dual or multiple admitting privileges to allow for the treatment of any of their patients in the most appropriate institutions.

7. That hospitals with approved internship and residency programs expand the setting of those programs so that the specialty being developed be experienced within ambulatory, chronic disease, ECF, and community hospital settings. (pp. 66-75)

8. That the number of inpatient beds within the Commonwealth of Massachusetts be planned by using the following usage rates as upper bounds for each service and/or age group. (pp. 40-57; App. D)

Service	Total Patient Days Per Annum
Obstetrics	73-89 patient days per 1,000 total population
Pediatrics	300-450 patient days per 1,000 children age 0-14 inclusive
Medical/Surgical	1025-1125 patient days per 1,000 population age 15-64 inclusive
	4200-4400 patient days per 1,000 population age 65 and older

a. that planning for future inpatient bed requirements of the population be consciously directed to reducing the total of the number of short-term inpatient medical/surgical, pediatric, and maternity beds to less than 4.0 per 1,000 population in the immediate future with a long-term objective of no more than 3.5 beds per 1,000 population.

SUMMARY OF FINDINGS

The use of hospital resources is most determined by the age and sex mix of the population, the ability of the population to pay for the services, the availability of hospital beds, and various "incentive" (or disincentive) schemes such as prepayment and utilization review. As age increases, more use of hospitals will occur. In general, the components of hospital usage - length of stay and admission rate - increase as age increases. The general exception is the child bearing years of the female where the admission rate will increase dramatically because of maternity admissions. The ability of the population to pay for hospital services will cause a significant increase in the use of hospitals. Most of this increase is accounted for by admission for surgery. Prepayment schemes offer an incentive to keep people well. They discourage unnecessary hospital admissions and lengthy hospital stays. Utilization review can be either preadmission review or review of length of stay. Retrospective review of admission or length of stay have, in general, little impact on hospital usage. Utilization review appears most effective when it is based on developed standards, is concurrent, and is conducted by persons not affiliated with the hospital which contains the cases being reviewed. The availability of hospital beds is the largest, single, determining factor in the use of hospital in-patient services by the population. The relationship between hospital usage and bed-availability appears to be linear. Although not conclusive, it is doubtful that the population of Massachusetts would have a "lower health status" if the bed-population ratio was 2.5 beds/1000 people

as opposed to the current ratio of 4+/1000.

The basic elements in the hospital sector are the hospital beds-pediatric, obstetric, medical-surgical, and psychiatric. Excepting for areas of geographic isolation, the minimum size of a hospital in an urban setting should be 200-300 beds and, in a rural setting, 100 beds. The minimum size of a maternity service should be 2000 deliveries per year (approximately 20 beds). The minimum size of a pediatric unit should be 20 beds. No measure is known for a psychiatric unit.

Hospital size should be as large as possible. The hospital system should consist of secondary institutions and large tertiary institutions which also provide secondary care. Formal referral relationships should be established among secondary and tertiary institutions. Going beyond merely short-term hospitals, formal affilations should be established with chronic disease hospitals, clinics, ECF's, and home health services. The doctor should be responsible for the continuing care of his patient and make use of all the settings.

The training programs for health professionals should be reformed to include training in the ambulatory, chronic disease, and ECF facilities and in the community hospital. Programs for chronic disease and primary (family) care specialists should be encouraged.

The total number of hospital beds needed should not be developed from formulas which may project past and present misbehavior into the future. Estimates should be made on the basis of age-sex mix of the population with ability to pay

being partialled out. Indications are that the population of Massachusetts would need, under a prepayment scheme, from 2.2-2.5 beds per 1000 population broken down as follows: OB - .3, Ped. -.2-.3, Med.-Surg. -- 1.7-1.8; and under the current scheme would need 4.1-4.6 beds per 1000 population: OB--.3, Ped.--.3-.5, and Med.-Surg.--3.5-3.8. The difference in the need is not so much an effect of the prepayment incentive as it is an effect of constraining the availability of beds.

Any alteration in the emphasis within the health system can be apparently made by manipulating two variables: availability of resources and financing. The certificate of need process can be used to affect the former and the rate-setting mechanism can be used to affect the latter.

FUNCTIONS OF THE HOSPITAL

The development of standards and guidelines for the determination of need of hospital facilities must begin with a definition of what functions hospitals perform. Hospitals have four basic functions - medical care (service), education, research, and survival (economic). There is no unanimous agreement that all these are rightfully functions of a hospital. There is less agreement concerning what each of these functions should be. The initial discussion below will attempt to define these functions.

I. MEDICAL CARE (SERVICE)

The hospital, as an institution, functions in a variety of ways to give medical-care services to the community. The hospital offers inpatient care, emergency care, ambulatory (out-patient) care to the community. In addition, the hospital offers the services of its ancillary departments (e.g. laboratory) to the community for diagnostic purposes (i.e. instances where the person in question is not located in the hospital setting.) In-patient care is given to a patient admitted into and assigned to a bed within the hospital. Emergency care, as defined here, is given on a non-scheduled basis to an individual who is a trauma victim, who requires immediate attention, and who is not an inpatient of the hospital. Ambulatory (out-patient) care is care given to an individual who is not an inpatient of the hospital and does not require emergency care. Ancillary medical services are available to all patients of the hospital-emergency, outpatient, and inpatient-and may be available for aiding in the care of non-hospital patients.

II. EDUCATION

The hospital can serve three primary educational functions - formal training of health manpower, continuing education of health manpower, education of the health consumer. The formal training of health manpower may be subdivided into three areas: education offered as part of a program of an academic institution, education offered by the institution (hospital) itself for further formal training requirements of health manpower, and education offered to promote the qualifications of health manpower but not related to the formal award of a degree, license, etc.

Medical schools and nursing schools commonly establish hospital-based "course" credits as a condition of degree award. Hospital-based "courses" may also be prerequisite to the award of degrees in such areas as hospital administration, laboratory or radiological technology, and physical therapy. These are examples of education as part of a program of an academic institution.

Many hospitals have formally recognized internship, residency, and fellowship programs for individuals with medical degrees to aid the individuals in obtaining the necessary requirements for the practice of medicine. Internships are also available for individuals with degrees in psychology, hospital administration, and other areas where formal practice may require internship. These are examples of institutional education for formal requirements.

Hospitals may set up formal training programs for individuals to make them more capable of performing their jobs or

to make them capable of performing other jobs. These programs, generally on-the-job training programs, are not associated with any degree, licensure, or certification requirements.

The hospital functions as a place for continuing education for health manpower, both formally and informally. Formal job-evaluation schemes instruct hospital employees in the procedures of their trade. Utilization review committees can show physicians what procedures are best, what are necessary and unnecessary. Formal staff meetings can be used as educational forums. Lectures and grand-rounds provide a formal framework for continuing education.

The hospital, simply as a gathering point for health providers, offers the greatest potential for continuing education. Through consultation, discussion, and observation, health professionals are kept abreast of the arts of their professions. Probably no educational experience is more important than this one for the providers of health.

The hospital also may assume a role as a formal educator of the consumers of health care. Either offering specific programs (e.g. family planning and lead-paint poisoning) or in general programs ("your health"), the hospital communicates to the consumer how to care for himself. Additionally, hospitals can (and do) educate the consumer in the proper utilization of health services - a critical subject.

III. RESEARCH

The research which can be performed within a hospital must be broadly defined over all areas relating to patient care.

While research is commonly thought of in relation to the development of drugs for the prevention or treatment of disease, patient care is much broader than the administration of drugs.

Research may be conducted in hospital labs with or without any human specimens. Research can require the use of patients, as subjects and controls. Research may cover hospital design - for efficiency and effectiveness of patient care. Research may be toward the development of new equipment for the diagnosis, treatment, and rehabilitation of patients. Research may cover experimentation with different medical records systems. Research, in short, may be experimentation in any area connected with providing care to individuals in an efficient and effective manner.

IV. SURVIVAL

The hospital must support the activities which it undertakes in each of the above three functional areas. Support of the hospital's activities is obtained by patient-income, endowments, grants, loans, and fund-raising (income from properties may be liberally interpreted as from endowments). If a hospital can support by these means the activities which it undertakes, the hospital survives. If there are some activities which a hospital budgets for but which cannot be supported by income received by the hospital, the hospital must drop those activities. If a hospital cannot support those services which it is required to provide, the hospital cannot survive.

Because the survival of a hospital is largely dependent upon patient-revenues, the third-party payment schemes are vital in determining what hospital activities can or cannot survive. It is vital, then, that the hospitals, the government, the people, and all other interested parties determine what is necessary, what is marginal, and what is unnecessary.

INPATIENT SERVICES

The basic unit of a hospital is a bed. The bed is the building block. It is elemental. The organization of the beds-the elements-with each other and with supporting activities is what gives the hospital its physicial make-up.

Beds are grouped into what may be called manageable units. A manageable unit is herein considered to be a nursing unit. Nursing units are subsets of nursing services. A nursing unit may be a proper subset of a nursing service (i.e. several nursing units make-up the service) or it may the set itself (the nursing unit is the nursing service.)

Nursing units for patient care may be a part of any one of the following nursing services.

1. Medical
2. Surgical
3. Obstetrics, including nursery
4. Pediatrics
5. Psychiatric

The above five services are the general patient-care services which a hospital offers to its bedded patients.

Each general service may be subdivided into nursing units which handle specific types of patients. Subdivisions may be by sub-specialty (or subspecialties) of the broader service or by peculiarly acute-care requirements for the maintneance of the patient. Subdivision by sub-specialty generally occurs only in hospitals which are so large (or so specialized!) that the average patient load can meaningfully support such subdivisions. Examples of sub-divisions by specialty are gynecologic units, diabetic service units, orthopedic units, and

alcoholic units. Subdivision by acute-care requirements occurs in hospitals of all sizes. Examples of these subdivisions are coronary care units and intensive care units. Large (or specialized) hospitals may have further subdivisions of these units or other specialized units which the patient load can support. Examples of these are surgical intensive care units (ICU's) medical ICU's, respiratory ICU's, newborn ICU's, and burn isolation units. (It should be noted here that patients within a nursing unit are not necessarily homogeneous by service).

Supporting these patient-care services are various "maintenance" services. Common to most all hospitals are the following "maintenance" services:

1. Dietary
2. Housekeeping
3. Laundry and linen
4. Central sterile supply
5. Central general stores
6. Plant maintenance and operation

Whether these are entirely inhouse provided services or are contracted for, a hospital must have these in order to support the patient care services.

For macro-planning purposes, maintenance services may be considered as "wrap-arounds." A wrap-around is a minor activity which goes along with a major activity. When the major activity is planned, the minor activity - the "wrap-around"-must exist. Consequently, maintenance services, for macro-planning purposes, may be dismissed as a concern.

Additionally supporting the patient-care services are various services which are diagnostic, restorative, and therapeutic or which assist in the delivery of these (the diagnostic, restorative, and therapeutic) services. These services are generally delivered from or conducted within specific locations within the hospital. These include:

1. Laboratory
2. Radiology
3. Physicial medicine (therapy)
4. Pharmacy
5. Operating and recovery
6. Delivery and labor
7. Medical social service
8. Blood bank
9. Medical illustration
10. Anesthesiology
11. Dental
12. Library (medical)

This list is not exhaustive. It contains those basic "assistive" services which a hospital may offer. Each of the items on the list may be subdivided into many activities. Radiology, for example, is readily divisible into two major categories - diagnostic and therapeutic - with further sub-divisions. Laboratory, likewise, can be divided into clinical and pathological and each can be divided into a multitude of sub-subcategories. Often, BMR, EKG, and EEG are broken out as

major services in themselves. Services such as inhalation therapy and cardiac catherization are not listed but easily could be.

Many of the assistive services are, like the maintenance services, wrap-arounds. A hospital must have in-house or contract for laboratory services and pharmaceutical services. But, unlike the maintenance services, the assistive services are not all compulsory to the existence of an individual institution and, consequently, cannot all be considered as "wrap-arounds."

The next grouping of services which are commonly available are the administrative services. Those "general" administrative services which can exist to support the patient-care services (usually indirectly) are:

1. Medical records
2. Accounting
3. Purchasing
4. Personnel
5. General

This list is not exhaustive, either. Public relations and auxiliary services are commonly found in hospitals. The administrative services are, in general, wrap-arounds. Each of the services listed above must exist to support the patient-care services which a hospital provides.

While all services which a hospital provides are related to the patient-care services, there are some services which may be considered "several steps removed" from the direct

provision of patient care. These services are educational and research. The education services which are part of formal training programs are geared generally towards the following groups:

1. Medical students
2. Interns and residents
3. Nurses
4. Technicians

Education services can be much more than formal training programs but, like research, will not be more specifically defined here.

BASIC DETERMINANTS OF THE HOSPITAL SYSTEM

The primary units of the hospital have been defined as the beds which are so organized to provide medical, surgical, obstetric, pediatric, and psychiatric services. These five categories of beds will be used as the basic identifiers of the hospital.

Having five "categories", it would appear that any combination of the five may "identify" a hospital. This, theoretically, is correct. However, the nature of medical practice clearly dictates that medical and surgical are not "free-standing" but must be combined when speaking of delivering inpatient care. Therefore, the five categories will be reduced to four categories with one category being defined as medical-surgical.

Having done this, the combinations of the four categories which may exist can be listed. The following abbreviations will be used:

MS = Medical-Surgical
P = Pediatrics
O = Obstetrics
PS = Psychiatric

The 15 combinations which can exist are:

MS	MS-O	MS-P-O
P	MS-PS	MS-P-PS
O	P-O	MS-O-PS
PS	P-PS	P-O-PS
MS-P	O-PS	MS-P-O-PS

Having thus identified the 15 types of hospitals which may exist, it is important that some definitions be attached to the basic categories in order to gain a proper prospective.

A medical-surgical bed "can" service patients of all ages and both sexes for medical-surgical problems.

A pediatric bed is age specific. Children requiring any type of medical-surgical care qualify for a pediatric bed. (The question of what age level determines a pediatric case is unanswerable. The most commonly accepted definition is an individual who is 13 years or younger. This is not at all universal. The Commission on Professional and Hospital Activities has shown that its member hospitals use varying age break-offs for admissions to pediatric beds. Yale University recently had assigned pediatricians to undergraduates and internists to graduate students.)

An obstetric bed is sex (female)and condition (pregnant) specific. While an obstetric bed is generally used by a woman who is about to or has terminated her pregnancy, it need not be restricted to pregnancy termination. Conditions ("complications") of pregnancy may dictate an admission to an obstetric bed.

A psychiatric bed" can" service patients of either sex and of any age. A psychiatric bed is condition specific. An admission to a psychiatric bed is an individual who requires treatment for mental, emotional, or behavioral disorders.

Before proceeding into an in-depth analysis of the structure of the short-term inpatient systems, some superficial comments may be made which will permit the elimination of some of the 15 hospital-types indentified above.

A psychiatric patient often must receive medical treatment in addition to or as part of his program for psychiatric care. A grouping of a psychiatric service solely with a medical-surgical service implies that (by the common denominator) the psychiatric patient can be of any age and either sex. A grouping of a psychiatric service solely with a pediatric service implies (by common denominator) that the psychiatric patient must be a child. A grouping of a psychiatric service solely with a obstetric service is illogical (by common denominator). Thus, the O-PS hospital is illogical.

An obstetric patient is a female who is being treated for conditions associated with her pregnancy (including the post-delivery care). While the medical expertise required for proper obstetric care is different from that required for proper gynecologic care (a specialty of medical-surgical group), the common denominator is the same (a woman). The nursing care ("approach", particularly) of the obstetric patient is very similar to that required by the gynecologic patient. In addition, the gynecologic patient in many instances can be placed in the same nursing unit as the obstetric patient(and vica-versa). The gynecologic patient is a scheduled admission, in general. The obstetric patient is somewhat unscheduled ("emergency"). By grouping obstetrics with gynecology, the ability to better utilize beds is apparent (e.g. the scheduling of

gynecologic patients to "fill" obstetrics bed when there is slack). Because of the common denominator and efficiencies which result, the obstetric bed, divorced from the medical-surgical (gyn) bed, is not completely logical. Thus, every hospital-type which does not contain O and MS is somewhat illogical. These combinations are O, O-PS, P-O, and P-O-PS.

The elimination of 4 hospital types leaves the following possible types:

MS	MS-O	MS-P-O
P	MS-PS	MS-P-PS
PS	P-PS	MS-O-PS
MS-P		MS-P-O-PS

The primary consideration now is what combinations of the above type hospitals can give the people all the patient-care services which are necessary to the best maintenance of their health. It is obvious that if a community has access to only a P-PS hospital, then the community is not getting adult psychiatric, obstetric, and adult medical-surgical services. Similarly, a community which has access to only a MS-O and a P-PS will not have access to short-term adult psychiatric care. On the other hand, a community which has access to a MS, MS-O, MS-P-O, and a MS-PS may be paying an excess for these services.

At the same time, it must also be recognized that the existence of P, O, PS, and MS services within a community would not necessarily provide all the services which the people may need. Within each service (particularly pediatrics and medical-surgical) there exist so many specialties that the mere existence of an MS or P bed does not guarantee that all the

special services are being offered. In fact, depending upon the locale of the MS or P bed, many of the specialized services should not be offered.

The question which must be addressed now, before developing any combinations of hospitals, is "what is both effective and economical?"

SIZE OF HOSPITAL AND HOSPITAL UNITS

The absolute minimum size of a separately identifiable (and designated) pediatric service should be 10 beds. The optimal minimum size of a separately identifiable pediatric service should be 20 beds. If the average daily census of pediatric patients is less than 10, it is advisable to reserve a sufficient number of medical-surgical beds which have a versatile use.

The 10 bed minimum is dictated by the minimum size of an effective nursing (management) unit which must be properly staffed and have the suitable supplies. The 20 bed nursing unit can be more flexible and more efficient in the use of resources.

The minimum number of deliveries which should be handled in an obstetrical service ranges from 1500-2500. This size justifies separate nurse staffing and speicalization in the delivery suite, newborn nursery, and maternity. While these numbers of deliveries can justify separate services and specialization, a greater number of deliveries is preferable so that observation and isolation units can be fully justified.

Fifteen hundred deliveries a year translates into 20 beds. Thus, the minimum obstetrical nursing service should be 20 beds (utilized approximately 70% of the time with an average length of stay of 4.0 days actually translates into 24 beds).

The minimum number of short-term psychiatric beds in a separately identifiable psychiatric service has not been adequately determined. The modes of delivering psychiatric services of all kinds to the public is so rapidly changing that any assessment of minimum management size is difficult. However, the minimum management unit, if alcoholic detoxification and drug withdrawal programs are excluded, seems to be somewhere

from 10 to 25 beds.

The minimum number of short-term beds in a separately identifiable medical-surgical specialty service should be no less than 10. The preferable minimum size should be roughly 20 beds. That is, if a particular section of a hospital is to be designated to serve only a particular subspecialty (e.g. orthopedics, urology, oncology, gynecology), then that section should be no less than 10 beds. The reasons, assumably, for a section to be separately designated for a particular type of patient is that particular resources and expertise are needed to care for the patient. The patient census which requires these specialized resources and skills must justify the existence of a separate nursing unit, and the minimum nursing unit for economic and service efficiency is roughly 10-20 beds.

The absolute minimum size of a hospital should be no less than 100 beds. This minimum size of 100 beds may and should be reduced if the density of the population is so small that accessibility to proper emergency medical services (inpatient) dictate a hospital of lesser size (accessibility will be discussed later). However, geographic proximity of hospitals whose total bed capacity is greater than 100 should, in every instance, make 100 beds the minimum size requirement of a hospital.

The minimum size of a hospital in an urban area should be no less than 200 beds. Additionally geographic proximity of hospitals whose total bed capacity is greater than 200 is sufficient to warrant the requirement of a hospital of minimally 200 beds.

The reasons for minimal size requirements for services and for hospitals are primarily economic but also bear considerably on patient care. From an economic viewpoint, it can be theoretically proven and has been operationally proven that if the basic service mix of a hospital remains constant, then the per diem cost decreases as the hospital increases in bed-size (assuming a constant occupancy rate and efficient use of services). Studies have shown that these economies can be realized continuously as the size of the hospital increases - as long as service mix and occupancy rate remains constant. If a bottom does occur (the point at which per diem costs no longer decrease but begin to increase), the studies indicate that this point lies somewhere between 500 and 600 beds.

The reason that "economies" can exist if service mix remains constant and resources are effectively utilized is that many resources do not vary (change) in the same proportion as beds vary. Stated in different terms, if the number of beds are doubled and service mix and utilization characteristics remain constant, then many resources required will be less than doubled. The most obvious area in which economies may be realized is the manpower required for the maintenance services. Proportionally fewer people would be required to run the dietary service, the housekeeping service, the laundry and linen service, central and sterile supplies, etc. as the size if the hospital increases (other things remaining constant). Additionally, capital resources - plant and equipment - for the maintenance activities could be proportionally less.

These economies in resources -manpower, plant, equipment - are also readily realized in the administrative areas. The assistive services and the patient-care (medical) services also realize economies, though the economies realized by the medical services are less dramatic than those realized by the maintenance and administrative services.

To this point, service-mix has been assumed to remain constant. But service-mix itself can vary (within limitations) as hospital-size increases, and economies can be realized. The reason for this is that there exist common resource requirements for all services and common resources for many combinations of service. For example, the maintenance services are, generally, required by all hospitals, regardless of service orientation. In addition, administrative services are, in general, common regardless of service orientation. Thus, two hospitals of 150 beds each (for example) offering totally different services would be able to operate less costly as a 300 bed hospital because of economies realized in the maintenance and administrative services.

Indeed, in the above situation, significant economies may well be realized in the assistive services. The resources required to operate the pharmacy, laboratory, radiology, and other services may well be proportionally less. This is because some of the assistive services are required by all medical services; and some of these services, while not being required by all the services, overlap.

Another way of realizing economies through a larger hospital size is through the better utilization of peculiar services. For example, a supervoltage x-ray unit used for radiotherapy should have a full-time radiotherapist, specialized full-time technicians, and peculiar support personnel (to properly operate it). The machine itself, operating at a normal work week, can handle upwards of 7500 treatments per year. If two hospitals of 150 beds (for example) each have their own unit and each unit gives only 3500 treatments a year, then a 300 bed hospital having the same service mix can increase its utilization of these resources while needing only one machine. Although less dramatic, there do exist many specialized pieces of laboratory, radiologic, and therapeutic equipment which are available in hospitals because they are needed (at times, regardless of size) but which are not fully (although are efficiently) utilized. By having a larger size hospital, these resources can be better utilized (duplication eliminated).

This last illustration can be expanded to explain, to some extent, why specific services (e.g. obstetric, pediatric, specialized medical-surgical) should be of a minimal size if separate areas are to be designated for them. If resources - manpower, plant, and equipment - are available for the proper operations of a specialized (specific) service, then many of these resources are subject to"economies"related to size. A properly run obstetrics service must have, associated with it, delivery rooms, labor rooms, a nursery room, etc. and should

have specially trained nurses, an observation room, etc. Most of these resources are required if an obstetrics service does exist. Many of these resources will not be fully utilized or efficiently and effectively utilized unless some minimum census can be maintained. If the minimum census cannot be maintained, then improper utilization is not readily justifiable.

Extending this a bit further, within each service (even those specialized) there exist special procedures and/or treatments which require highly specialized equipment and knowledge. If the availability of this specialized equipment and knowledge is not necessary for emergency services, then underutilization of these services can result in a "cost to the system." For instance, if several surgical services (i.e. thoracic) within different hospitals have the necessary resources to perform open-heart surgery and the capacity of each is, say, ten such procedures a month, then there is improper utilization of the specialized resources if each service does only two a month.

The improvement in medical care which may result from having minimum hospital and/or service size may exist because: (1) the medical and nursing staffs may gain experience through handling more cases requiring similar treatments and/or procedures and (2) a minimal size may justify the inclusion of specialized resources which could not be justified for sizes less than the minimum. Thus, two hospitals in the same geographic area which have the same mix of services and are each of 150 beds in size (for example) could offer the staffs a better basis for experience if there was just one 300 bed

hospital. Similarly, one obstetric service which accounts for 2500 deliveries per year may not only have better experience in handling premature and low gram-weight births than two services half the size but may also have the specialized equipment and areas for the handling of the problem births.

Having given consideration to the minimum sign of hospitals and services, it becomes proper to address two additional areas before alternative designs of short-term, inpatient resources can be addressed. These two areas are: (1) Accessibility and (2) Variables affecting utilization of short-term inpatient utilization.

ACCESSIBILITY

The variables which primarily impact on accessibility of short-term inpatient services are: (1) emergency cases, (2) patient, physician, and social convenience, (3) economics of travel time, (4) continuity of care, (5) physical capacity of the patient to travel. Each of these are very interrelated and shall be explained below.

In explaining the significance of the above "five variables", it is best to start with the assumption that all short-term services be located in one place and to discuss the logic (or illogic) of this assumption. The logic of the assumption is as follows: if all resources for providing short-term inpatient services were located in one place and properly managed, then there would be no duplication of services and the cost of providing the services would be at a minimum. If this is correct, then why are all the inpatient services not so centralized?

The first argument is that emergency care places a maximum travel time on distance to the short-term inpatient services. If a person were critically injured in an auto accident or in a fall and if the inpatient resources were two hours away by auto-ambulance, then those inpatient services might as well not exist. Even if an air-ambulance could be dispatched, the distance to the centralized location may be too great an obstacle to overcome. Unfortunately the maximum "allowable" distance" of a short-term inpatient service from emergency medical cases is unknown. The medical profession has sufficiently documented that it is required to get a stroke victim,

a MI victim, or any severe trauma victim to the hospital as soon as possible and that zero time would be the best. But, it is still somewhat of an unknown if the maximum "allowable" time is 5 minutes, 10 minutes, or 60 minutes? This all depends on how the emergency system is constructed.

Connected closely with the above is the economics of travel time. When associated with emergency medical services, the economies of travel time usually takes on a one-dimensional feature. The feature generally assumes the existence of a hospital and/or hospital service and then tries to calculate the most cost-effective means of utilizing transport services (auto-ambulances, air-ambulances, fire and police vehicles, etc.). The location of the service and/or hospital is not frequently considered to be variable, as it should be. However, effective analysis can only be done when "allowable" times are placed on the distance of the service to the populace.

The economics of travel time can readily be divorced from emergency services and applied to the patient requiring "elective" treatment. Here, the cost of travel to the patient and, possibly, the loss in hours of productivity must be measured. (The cost of loss of productivity may be ignored because the patient probably will not go to work for a part-day anyway immediately prior to admission or after discharge.)

The real economies of travel time are found not to be associated with the patient himself, but with his family and friends. The greater the distance necessary to travel, the greater the cost of traveling-transportation costs, lodging costs, and lost-productivity costs.

Additionally associated with this travel time is the psychological cost of patient care. The patient, himself, may be inhibited in proper recovery because he is "so far from home." The further the travel time, the fewer will be the visits of friends and relatives. (To some patients, this may be a favorable condition for recovery). The effect of this is very difficult to say.

Travel time and patient-condition are also highly relevant. If non-emergent, the accessibility (travel time) of the hospital is not generally restricted by condition prior to admission. However, discharge of a patient may well be affected by travel time considerations. A patient capable of traveling several miles may well be held for extra days within a hospital because his condition cannot allow him to travel all-the-way home. (Additionally, at times a patient may be capable of being discharged from a referral hospital to his "less costly" community hospital but the distance prevents this).

Continuity of care as associated with physician convenience is also critical. Physicians who serve the ambulatory needs of a population may also provide much of the inpatient services. The travel time of these physicians translates directly into a loss of service availability to the people. Even if a physician does not deliver the inpatient service, that physician may be required to continue the care of the patient upon discharge. This often means that the physician must visit the patient (and managing physicians) within the hospital to be able to deliver the proper, continuing care.

To now summarize, the accessibility of a hospital's services to a population is largely dependent upon the requirements of emergency services. There is no "maximum allowable time" limit yet known which satisfies this requirement which, in itself, is dependent upon the arrangement of the entire emergency medical service system. Accessibility when defined as travel time plays an important role in the cost effective analysis of such things as patient travel costs, family and friends travel cost, physician travel costs, and the costs of overstay due to travel time restrictions of the patients condition. There are also subjective considerations which are difficult to measure. Thus, no maximum allowable travel-time can be broadly determined.

MEASURES OF UTILIZATION, VARIABLES AFFECTING UTILIZATION, AND THE EFFECT OF VARIABLES ON UTILIZATION

Measures of Utilization

Hospital use can be measured in many ways. There are the absolute measures: total number of patient-days, total number of admissions, and total number of persons hospitalized. There are the relative measures: hospital days per year per 100 or 1000 persons, the length of stay, the admission rate, and the frequency of hospitalization. The difference between absolute and relative measures is that relative measures are measures which are related to some group of people and thus have a denominator. Absolute measures require no denominator. For example, the total number of hospital days consumed by Blue Cross subscribers in a given year may be listed as 1,500,000 days while the hospital days per year per 1000 persons (i.e., per 1000 persons eligible) may be listed as 1.250 per person per year. The reason why relative measures are crucial is that relative measures allow for comparisons from year to year or from group to group while absolute measures do not lead to comparison. Because comparison is crucial for planning, the relative measures are more useful; but each of the measures will be defined below:

Total number of patient-days- the total number of days spent within a hospital, usually in a given time period.

Total number of admissions- the total number of formal entrances into a hospital, usually in a given time period.

Total number of persons hospitalized- the total number of different people admitted into a hospital, usually in a given time period.

Hospital days per 100 or 1000 persons- the total number of hospital days spent within a hospital per 100 or 1000 people of a designated population, usually for a given time period.

Admission Rate- the number of formal entrances into a hospital per 100 or 1000 people of a designated population, usually for a given time period.

Length of Stay- the number of days per stay of an admitted patient.

Use Rate (Frequency of Hospitalization)- the number of different people admitted into a hospital per 100 or 1000 people of a designated population, usually for a given time period.

Each of these measures can be related to one another through the use of appropriate formulas:

Total number of admissions = (total number of persons hospitalized) x (average number of admissions per person hospitalized).

Total number of patient days = (total number of admissions) x (average length of stay).

Admission Rate = (Use rate) x (Average number of admissions per person hospitalized).

Hospital days per 100 or 1000 people = (admission rate) x (average length of stay).

Variables Affecting Utilization

There are as many variables which can explain (effect, are correlates of) hospital utilization as there exists the ability of an individual to define variables. The reason for this is that the utilization of health services contains elements of both the socio-political sciences and the life sciences. However, several studies have attempted to categorize and list the variables which could explain hospital utilization. The categories of lists from two of these studies are listed in the following paragraphs.

One of the most comprehensive listings of variables reviewed for their effect on utilization of health services was recently published by Purdue University. The study was financed specifically to review all relevant studies of utilization of health services and to develop indicies and correlates. The list given below is from this study.

I. Predisposing Variables

A. Socio-demographic correlates

1. Age
2. Sex
3. Education
4. Marital status
5. Family size and composition
6. Race and ethnicity
7. Religious preference

B. Socio-psychological correlates

1. General health care attitudes
2. Knowledge and sources of health care information
3. Situation- specific stresses
4. Generalized stresses
5. Patient-physician interaction

C. Previous health behavior

II. Enabling Variables

A. Economic correlates

1. Socio-economic status and occupation
2. Income
3. Price of medical services
4. Methods of financing

B. Organizational correlates

1. Alternative organizational forms
2. Type of practice

C. Availability of Resources

1. Region
2. Residence
3. Distance
4. Supply of medical personnel and facilities
5. Regular source of care

III. Need Variables

A. Health and mobility status

B. Perceived symptoms of illness

C. Physician-related urgency

D. Chronic activity limitation status

E. Disability days

F. Diagnosis

G. Surgery

A more modest listing of variables was included in a study in Michigan published in 1962 which was designed to look into hospital and medical economics. The variables considered in this study were:

I. Need for Care

1. Age
2. Sex

II. Ability to secure and pay for care

1. Insurance coverage

2. Income relative to family size
3. Sick leave
4. Savings available
5. Race

III. Willingness: Standards of Care and Attitudes

1. Attitude toward early care
2. Education of head of family
3. Region where family grew up

The studies reviewed in preparing the Purdue Study (the first list of variables) indicated that some of the variables were not related to hospital utilization and that others merely "acted" through their association with other variables. The "non-explanatory" variables, with a brief description, were:

1. Marital status- the marital status variable primarily reflects age, sex, and morbidity patterns.
2. Family size and composition- the effects of family size and composition are linked with the income, age, and sex variables.
3. Religious preference- no strikingly consistent relationship between this variable and utilization appears in the current empirical literature.
4. General health care attitudes- little relationship has been consistently shown between health beliefs, medical orientation, perceived availability of medical care, etc., and utilization. (The ambiguity of the studies gives little utility to using these variables as predictors.)
5. Knowledge and sources of health care information- relationship between this variable and utilization is through its interaction with the education variable.

6. Situation-specific stresses - the apparent difficulty in measuring this variable ("perceived susceptibility", "perceived chance of recovery", "psychological readiness") leads to ambiguities for prediction.

7. General stresses- the limited number of studies prevent definitive conclusions.

8. Patient-physician interaction- nothing

9. Previous health behavior- has an association with ambulatory care (particularly preventive) but has not been shown to be associated with inpatient utilization.

10. Socio-economic status and occupation- this variable incorporates education, occupation, income, and race.

11. Region- measures are among the several regions of the United States.

12. Distance- affects utilization by the same measures as the "supply" variable.

13. Regular source of care- little connection with hospital utilization.

14. Need variables- all the need variables are either unrelated to utilization or related through other variables. Additionally, they are specific to "illnesses", in general, and do not readily convert to "population" (demographic characteristics).

The Michigan study found that age, sex, insurance coverage, and income level were the variables which were most significantly "correlated" with hospital utilization.

Education of family head, attitude toward early medical care, and region of family origin had no distinguishable affect on utilization; and race, sick pay benefits, and savings were not analyzed.

While it is obvious that many variables can be and have been shown to be correlates of hospital utilization, only a few are truly necessary to incorporate into any macro-planning study. The two which must be included are age and sex. The next four which are vital are insurance coverage, physician and bed supply, regular source of care, and the organizational form (i.e., prepayment, fee for service, etc.). The next variables which could be included are education, income, and price of medical services.

Age plays the most significant role in hospital utilization. The Kaiser Foundation Health Plan, NorthernCalifornia, had total membership utilization characteristics as follows:

Age group	Hospital days per 1000 members	Discharges per 1000 members	Average length of stay (days)
0-19	182	41	4.4
20-44	469	99	4.8
45-64	816	95	8.6
65+	2154	196	11.0

The length of stay figures for the Kaiser group are almost identical with the length of stay reported by all hospitals in the West (California, Oregon, Washington, Idaho, Nevada, Arizona, New Mexico, Colorado, Utah, Wyoming, Montana, Alaska, and Hawaii) who are affiliated with a hospital abstracting system known as PAS. The PAS length of stay figures are:

Age group	Average length of stay(days)- West	Average length of stay (days)-East
0-19	3.9	4.7
20-34	4.3	5.3
35-49	6.4	8.0
50-64	7.8	11.0
65+	10.3	14.8
TOTAL	6.4	8.4

Included in this table are the length of stay figures for the East (Pennsylvania, New York, New Jersy, Massachusetts, Rhode Island, Vermont, New Hampshire, Maine, Connecticut). (These figures are for comparison). What this table shows, consistently, is that average length of stay increases with age.

Sex also plays an important role in effecting hospital utilization. Again, using figures from the Kaiser Plan, the following table is presented:

Age group	FEMALES			MALES		
	Hosp. days per 1000	Discharges per 1000	Av.len. of stay	Hosp. days per 1000	Discharges per 1000	Av.len. of stay
0-19	171	42	4.1	193	41	4.7
20-44	663	156	4.3	255	36	7.1
45-64	811	100	8.1	820	89	9.2
65+	1856	163	11.4	2442	227	10.7

The dominating reason for the difference in utilization is pregnancy. The average length of stay of an obstetrics admission is 3.3 days and the average admissions for obstetrics in the age group of 20-44 for the Kaiser population is roughly 100-110 per 1000 females age 20-44. If modification were made to eliminate maternity cases, the average length of

stay for the 20-44 female group would be about 6.3 days and the discharge rate 40-50 per 1000. Even with this modification, differences in admission (discharge) rates and lengths of stay exist for the sexes.

The Kaiser Plan membership population does not have the typical characteristics (age and sex frequencies) of the normal California or U.S. population. The age of the members is heavily skewed toward the below 65 groups. With the membership it has, Kaiser has been able to maintain utilization figures of roughly 490 hospital days per 1000 members and 78 discharges per 1000 members. But, Kaiser researchers, adjusting their figures to comparable California and U.S. population figures, show that, if their population were age-sex like California and the U.S., the following would hold: 604 hospital days per year per 1000 people and 87 discharges per year per 1000 people in California; and 613 hospital days per year per 1000 people in U.S. and 86 discharges per year for the same.

These figures are interesting because they lead directly into the next variable- organization of the services. The Kaiser Plan is a prepaid plan which charges its members a fixed monthly rate. The Health Insurance Plan of Greater New York (HIP) also is a prepaid group plan. Although it is difficult to estimate, there are about 15-25 large, well-established prepaid group plans in the United States.

The findings consistently show that members of prepaid groups utilize hospital services less than the average population does. The actual California figures for 1970 had 152 discharges per 1000 population, as compared to

Kaiser's 87 for all of California. In a study conducted on the Federal Employees Health Benefits Program, comparing hospital utilization among several states for Blue Cross, and Group Practice Plans- non-maternity in-hospital services, high option, the following was found:

State and Type of Plan	Annual Days per 1000 Persons (1967-68)
D.C., Virginia, Maryland	
Blue Cross	838
Group Practice	379
New York	
Blue Cross	725
Group Practice	468
California	
Blue Cross	825
Group Practice	422
Oregon	
Blue Cross	879
Group Practice	272
Washington	
Blue Cross	791
Group Practice	341
Hawaii	
Blue Cross	1364
Group Practice	404

There is difficulty, always, in stating the rate for the citizens of Massachusetts. The reasons for this are several: (1) There is no reliable figure for the number of days which Massachusetts citizens remain hospitalized; (2) There is no agreement on the number of people in Massachusetts. Consequently, the number of patient days, length of stay, and admissions are estimated from the number of total days spent in

hospitals in Massachusetts, and rates are found by dividing by the estimated civilian population of Massachusetts. The three organizations which do report hospital utilization in Massachusetts (Massachusetts Department of Public Health, Massachusetts Blue Cross, American Hospital Association) are not in complete agreement on the utilization figures. However, the rough estimate is that the average length of stay is between 8.8 and 9.0 days and the number of discharges per 1000 population is between 145 and 155. (These figures are for comparison with previous figures).

The Blue Cross figures, nationwide, for 1970 were 128 admissions per 1000 population with an average length of stay of 7.11 days, excluding complementary coverage to Medicare and FED. The FED figures were 129 admissions per 1000 population with an average length of stay of 7.32 days. The complementary coverage to Medicare resulted in 275 admissions per day (average length of stay undetermined). The total admission rate of <u>all</u> Blue Cross coverage for 1970 is estimated to be 142 per 1000 members.

While organization (or lack thereof) does have an apparent affect on utilization, the amount of coverage is also an influencing factor on hospital utilization. While many studies have shown this, the best example is from Blue Cross members who were enrolled in the Government-Wide Service Benefit Plan. There were distinct differences in those who held Low vs. High Option plans. The characteristics below clearly show that coverage affects utilization:

	Rate Per 1000 Members (1970)		
	Admissions	Days	Average Length of Stay
High Option	134	992	7.40
Low Option	90	580	6.48

The next variable, supply of beds, might easily be considered the most significantly influential correlate of hospital utilization. While this variable is often excluded from studies, it is strongly believed that it affects hospital utilization even more than the age variable. In a classic work done in England by Feldstein, an attempt was made to associate hospital usage (total patient days) with several variables, one of which was bed supply. Several attempts were made to "fit" some type of curve between the number of beds available and the hospital use rate. However, in all instances, the hospital use rate increased as the number of beds increased; and only when a relationship was created which forced a plateau did the number of beds "needed" reach a limit. (Interestingly, the elasticity of admission rate was greater than that of length of stay). The Kaiser Plan in California has long had 1.8 beds per 1000 members, although their planning ratio is optimally 2.0 beds per 1000 population. The Kaiser planners have openly stated that if 2.2 beds were available, even in their plan, the beds would be used.

The application of Parkinson's Law to hospital beds is a phenomena which is truly difficult to explain. The most logical explanation appears to be that medical practice adjusts to the availability of beds. Regardless of the supply

of physicians, it appears that more "emphasis" would be placed on hospital treatment the more beds there are available.

The next set of variables- education, income, and price of medical services- while important, will be excluded. The reasons for the exclusion of these are several, and many can argue (correctly, to some extent) that these variables should not be excluded. Education is excluded because this is a macro-planning project. The educational levels do vary from region to region in Massachusetts; but the variance is not significant. Coupling this with the fact that educational level does not significantly "explain" variances in hospital utilization, education may be excluded.

Income is excluded for the same reason, and one additional reason. While income does apparently have a dramatic effect on the utilization of ambulatory services, the effect of income is somewhat less on inpatient services.

The price of medical services,for the reasons above and an additional reason,is also excluded. Inpatient services are broadly covered by third-party payments. Because of this, the price effect (and the income level of the individual) is not felt as much in inpatient-services as in the ambulatory services. Indirectly, of course, the financing of in-patient services as opposed to ambulatory services may well affect hospital utilization- both by encouraging inpatient usage and by people delaying care until an illness is so severe that hospitalization is required.

Having briefly summarized the effect of variables on hospital utilization, it is now required to derive and translate utilization characteristics into bed figures.

Occupancy Rates and Utilization Rates

The occupancy rate is the prime factor in translating a utilization measure into a bed figure. A hospital bed which is occupied 90% of the time can provide 328 days of service. Similarly, a hospital bed occupied 85%, 80%, 75%, or 70% of the time can supply 310, 292, 274,or 256 days of care. Thus, if a population requires 620 days of care per 1000 people, then 2 beds occupied 85% of the time would be sufficient.

The translation of utilization to beds required is not that simple. The reason for this is simple. Utilization measures are average measures. A population which averages 62 admissions per year per 1000 people at an average length of stay of 10 days is not "going to play by the averages" - two patients are not going to show up every 10 days when the former two patients are about to be discharged. Because of this, there must be some "slack" in the system.

Management science has, for several years, addressed ways of "buffering" an operation from variances in demand. The typical way of doing this is to calculate the variance of the daily (weekly or monthly) demand from the average daily (or weekly or monthly) demand and then to work with the variance and not just the mean. Without going into lengthy explanation of this process, simple rules can be set forth for utilization rate by size of hospital service:

Service and Bed Size	Minimal Occupancy Rate
Medical-Surgical	
50-100 beds	75-80%
100-200 beds	80-85
200+ beds	85-90
Obstetric	
10-15	50-65
15-20	60-70
20-50	65-75
50+	75-85
Pediatric	
10-20	60-65
20-40	65-75
40-80	70-80
80 +	75-85
Psychiatric	Unknown

The reason why minimal occupancy rate increases with size is, basically, that by drawing from a larger population, the effects of variances in demand are somewhat dampened.. The reason why obstetric services have lower occupancy rates (minimal) is that the obstetric admission is a non-scheduled, short-length admission with minor seasonality effects. The reason why pediatrics is lower than regular medical-surgical is due to the length of stay and size of population group.

Even with occupancy rates set, the determination of beds needed is not easy because utilization measures are not easy to come by.

Currently, the Hill-Burton bed requirements are calculated by a formula which is applied to the total patient days in a given region. The formula is used to predict the total number of beds

five years hence in a region. The formula is:

$$\frac{TPD_0}{CP_0} \times \frac{ECP_5}{.85} = Beds_5 \times 365$$

Where

TPD_0 = Total Patient Days in Region in current year

CP_0 = Civilian Population in Region in current year

ECP_5 = Estimated Civilian Population in five years

.85 = Average Occupancy Rate

$Beds_5$ = Beds Needed in 5 years

There has been much criticism of this formula. The reasons for criticism are several. First, the formula tends to maintain and strengthen misallocated inpatient beds. If a population is shifting away from a given region or has shifted but still uses beds in another region (due to non-availability of beds in their own regions), then the formula will continue to allocate "unneeded" beds in the initial region "of strength." This is the effect of TPD_0. Second, the Hill-Burton formula is based on a point and not a sequence of observations. If total patient days per 1000 population has been declining or increasing, the Hill-Burton formula does not take this into account. The only increase or decrease adjustment which the formula makes is associated with the change in population. Third, the Hill-Burton formula does not segregate beds by major service: medical-surgical, obstetrics, and pediatrics.

If the Hill-Burton Formula did segregate beds by service,

did take into account trends in admission rate per 1000 people and in length of stay, and did attribute patient-days not to the region in which the hospital is located but in the region from which the patients came, then there would be only one further objection to the formula: it perpetrates a philosophy of medical service delivery which the people may not want to support.

All the information for making an accurate assessment of the number of beds needed is not currently at hand, and probably never will be. The medical sciences are too dynamic to allow for any accurate projection of future need. However, by using information already presented and some additional information, ranges of likelihood may be estimated.

The first estimate is for obstetrical beds. Obstetric beds are primarily used for women who are about to give birth or who have just given birth. In addition, obstetric beds may be used for complications of pregnancy and for some gynecologic patients. Roughly, an obstetric bed is used for a women who has delivered a child 85-95% of the time and from 15-5% of the time for other cases. The number of births per 1000 population in the United States is currently, approximately 17.5 - 18.0. (There is a distinguishable difference if this rate was broken into whites and non-whites). The trend had been decreasing over the past several years and now appears steady. It appears that 17.5-18.5 births per 1000 population is an upper limit for this figure. The average length of stay for women in obstetrical

beds has been decreasing steadily. The rate is currently 4.2 days but should be 4.0 days in the future. The applicable range (maximum) would be 4.0-4.2 days. Thus, the range of hospital days for delivery of babies would be roughly 70-77.7 per 1000 population. Additionally, the use of obstetric beds for cases other than "deliveries" would cause this to be multiplied by 1.05-1.15. Thus, the maximum total of obstetrical bed days would range from 73-89 days per 1000 population.

The great difference in the birth of whites and non-whites would indicate that in areas which are heavily non-white, this figure may be adjusted slightly upward. However, it should be noted that the birth rate in Massachusetts is significantly less than that for the nation as a whole (less than 17.0 births per 1000 population) and that the utilization of obstetrical services are generous estimates.

The utilization determinants (length of stay and admission rate) for pediatric beds are much more difficult to obtain for three reasons: (1) there is not universal agreement on the age limit of an admission to a pediatric bed; (2) many children get admitted to medical-surgical beds even if they fall within the pediatric range; and (3) it is not clear that all children who require inpatient care are obtaining that care.

The Kaiser statistics show that the age group of 0 to 14 years accounts for roughly 47 of the 488 total patient days per 1000 members. While it is unclear that all hospitalizations

of children under 14 years of age are in pediatric beds, 10% of the beds allocated (.18 of 1.8 per 1000 members) are pediatric beds.

HIP data in New York indicate that children under 15 account for 15% of the hospital days (80 of 549 per 1000 persons) used by the members under 65 years of age.

The HIP statistics indicate that for the age group under 15 the admissions per 1000 people and the hospital days per 1000 people are 49.6 and 277 respectively. The Kaiser statistics for the age group under 15 have 38 discharges per 1000 people of that age and 153 patient days of care per 1000 people of that age. United States averages (adjusted to Massachusetts population) yield 67 admissions per 1000 children under 15 and 340 days of care.

It can be assumed that in the Kaiser and the HIP populations the individuals were receiving the care needed, but the U.S. statistics may not reveal the total potential need for hospitalization of the people 14 and under.

The best estimates of hospital utilization for the average population come from individual studies. Dr. Joel Albert, a Boston pediatrician, while working at Children's Hospital, did a very good study from which the following is abstracted.

Families which had been frequent users of the emergency room for obtaining services for children were divided into two groups: one group was going to be given comprehensive pediatric care

while the other group (control) was to act as they had done in the past. Hospitalization rates (as well as other rates) were calculated for each group (per 100 members) for six month periods. The results are below:

Time Period (months)	Hospitalization Rate per 100 children	
	Experimental Group	Control Group
6	4.26	2.04
12	2.97	3.74
18	1.82	3.27
24	1.93	3.64
30	3.08	3.87

The initial high hospitalization rate for the experimental group was stated as being such because of previously unmet needs. (No explanation was given for the rise in the fifth period.)

These figures indicate that the admission rate for a properly cared for group would range between 40 and 60 admissions per year per 1000 (2.0-3.0 admissions per 100 per half year) and that the admission rate for a group with access to hospital services would range from 60 to 80 admissions per year per 1000 people. Thus, Dr. Albert's study group and control group apparently validate the Kaiser, HIP, and U.S. statistics.

The conclusion would be that children receiving care in an HMO setting utilize approximately 160-275 inpatient days of care per year per 1000; children receiving good care in a non-HMO setting would utilize 200-325 inpatient days of care of care per 1000;

and children receiving adequate care would utilize 300-450 in-patient days per 1000 population. (Above figures are roughly estimated from the admission rates given above and a 4.0-5.5 length of stay.)

Medical-surgical utilization characteristics have all the difficulties which pediatric statistics have. Foremost, is the fact that many people probably are not receiving the care which they require. Also, it must be remembered that the variables which affect care play a tremendous part in the utilization of hospital facilities - particularly insurance coverage and bed supply.

To give some indications of what medical-surgical utilizations would be if insurance coverage variable was, to some extent, dampened, the utilization characteristics associated with members in Blue Cross plans will be used. By doing this, the question of coverage (while not totally eliminated) may be reduced.

The Kaiser and HIP plan members have the following utilization characteristics for the age groups indicated:

Age Group	Admission Rate per 1000 people		Patient Days per 1000 people	
	Kaiser	HIP	Kaiser	HIP
15-44	91	84	429	520
45-64	95	77	816	862
65+	196	--	2,154	---

These figures contain maternity cases. If maternity cases were not included, it is estimated that the following utilization rates would have existed:

Age Group	Admission Rate per 1000 people		Patient Days per 1000 people	
	Kaiser	HIP	Kaiser	HIP
15-44	47	45	284	365
45-64	95	77	816	862
65+	196	--	2,154	---

These figures, adjusted to the age characteristics of the Massachusetts population, would give the following (for just medical-surgical admissions):

Age Group	Admission Rate per 1000 people		Patient Days per 1000 people	
	Kaiser	HIP	Kaiser	HIP
15-64	63	56	460	534
65+	196	--	2,154	---
All ages over 15	81	--	700	---

The Blue Cross summary of national statistics is listed below for five groups: (1) All Blue Cross regular members, excluding complementary coverage to Medicare and Federal Employees and Dependents (FED); (2) Individual contracts of Blue Cross regular members (as opposed to family contracts); (3) New England regular subscribers; (4) FED subscribers; and (5) Complimentary Medicare

Blue Cross Group	Admissions per 1000 members (1970)	Total Patient Days (1970)
1. All Regular	128	913
2. All Individual Regular	139	1,127
3. All Regular - New England	125	867
4. FED	129	945
5. Complementary Medicare	275	-

The first, third, and fourth groups include individuals of all ages and does include maternity cases. The second group - individual membership - probably excludes children and probably does not include maternity. The Complementary Medicare group is probably for the group 65 or older.

To attempt to get a rough estimate of what the regular memberships utilization characteristics would look like if maternity cases were omitted and if children age 0-14 were eliminated, several adjustments to the data were made. The average birthrate per 1000 individuals in the U.S. was approximately 19 in 1970. Maternity coverage is a separate coverage under Blue Cross and it is assumed that, because of this, the Blue Cross population had covered roughly half of the births - thus at a rate, which would be reflected in the utilization measures, of 10 births per 1000 members. With an average length of stay of 4.0 days, the total number of days for maternity care would be 40 days. Subtracting 10 admissions per year from each admission per 1000 members and 40 days from total patient days per 1000 members, the admission

rate and patient days per 1000 would be developed which excludes maternity.

If the age distribution of the population enrolled in regular Blue Cross plans was similar to that of the U.S. (excluding 65+ population), then approximately 1/3 of those covered by Blue Cross would be under 15. If it may be assumed that this group utilizes 375 patient days per year per 1000 persons and has an admission rate of 70 per year per 1000 members, then the following table would exist for regular members (excluding pediatric and obstetrics):

Blue Cross Group	Admissions per 1000 members	Hosp. Days per 1000 members
All Regular	142	1,122
Regular New England	138	1,053

It is not surprising that these totals resemble those for all regular members with individual contracts.

Statistics for the United States, as reported for the year 1969, tend to show that the overall characteristics of utilization of the populace are very closely alligned with the Blue Cross statistics, as edited. The U.S. statistics showed the following (aggregated):

	Admissions per 1000 people	Patient Days per 1000
15-44	156 (113)	912 (740)
45-64	163	1,625

The adjusted figure, which appears in parenthesis, eliminates maternity cases. The aggregate figures for the age groups 15-64, excluding maternity cases, are 140 admissions per 1,000 people and 1,025 patient days per 1,000 people. The similarity of these figures with the Blue Cross figures are quite unexpected.

However, the national figures for population 65 and over, are different from the Blue Cross (complementary coverage) figure.

The 65 and over group in 1969 had an admission rate of 305 per 1,000 people over 65 and required 4,416 per 1,000 people (average length of stay of 14.0 days). This national statistic, while influenced by several variables, is probably not a figure which reflects any "lack of services" due to insurance coverage because this age group has the benefits of third-party payments.

From the figures given above, it may be assumed that the utilization rate of hospital days for the age group of 15-65 for non-maternity matters is in the range of 1,025-1,125 with an admission rate of approximately 140. The admission rate for 65+ is probably around 300-305 per 1,000, and the utilization rate, assuming an average length of stay of 14.0-14.2, is 4200-4400 days.

Unfortunately, there is no way to assess the utilization rates for psychiatric admissions. There are several reasons for this. Most important, the delivery of psychiatric services to the citizens in Massachusetts is undergoing a drastic change. Massachusetts had

relied on state mental health facilities to handle most of the inpatient cases within the state. With the change toward de-institutionalization, there will be a requirement for many short-term psychiatric beds within community hospitals. Few, if any, reliable statistics exist for such a mode of handling the inpatient psychiatric requirements of the populace. Little data is available from the prepaid group plans in this area. In short, there are no statistics as yet found which could hint at appropriate utilization measures for patients needing psychiatric care.

Excluding the psychiatric services, it is required before ending this section to give some explanation as to the soundness of the measures presented in the obstetric, pediatric, and medical-surgical sections. The range of patient days given for obstetric utilization rate is probably a quite accurate figure which will hold throughout the 1970's. The range is conservative; and with adjustments for non-white populations when necessary, should be totally applicable. Trends, if taken into consideration, would make this range not low, but high.

The pediatric measures given should be fairly representative. The HIP and Kaiser plans are proud that, over the years, the utilization of their services has remained constant. The measures derived from Dr. Alpert's study are, themselves, felt to be fairly constant measures of the 0-14 years of age population. These should not

change over time. It should be mentioned, however, that these figures are what may be called "steady-state" figures. As Dr. Alpert showed, the initial effect of incorporating children in a comprehensive pediatric program was to cause a positive jump in hospitalization before a lower rate was realized. Thus, if tomorrow all the children would receive comprehensive care, the hospital usage would dramatically increase. While this should be taken into account in initialing programs, the ranges presented should hold in a steady state.

One additional comment is in order. The measures given are for the ages 0-14 inclusive. All the people in this age range can legitimately be admitted to a pediatric bed. However, many of these admissions could be admitted to medical-surgical beds.

The medical-surgical measures for HIP and Kaiser, like the pediatric measures, bear the consistency of time. The medical-surgical figures for the population in general and from the Blue Cross figures are not constant. Blue Cross regular members have slowly been increasing their usage of hospital facilities. Even within the regular membership population, Blue Cross studies have shown that the type of coverage (e.g. indemnity vs. full) affects the hospital usage measures. Even if adequate utilization review measures are imposed, the advent of a national health insurance program could (under the existing organizational framework of delivering care) drive these measures upward. The extent of the impact is not known; however, it may be safely assumed

that each of these measures would have to be inflated by 10% minimally, unless different organizational forms for delivering care come into being.

Without the advent of national health insurance, the figures presented will probably hold true for many "wrong" reasons. The pressure of having effective utilization review will (and has) caused the length of stay to consistently decrease over the past several years. Admission rates appear to have plateaued (and may even be somewhat declining). Thus, the slow creep upward during the late 1960's appears to have ended. Unless a national health insurance scheme comes into effect, these figures should hold.

One further point should be made about the "advent" of national health insurance. If a national health insurance package financially rewards inpatient as opposed to ambulatory care, inpatient services will be dramatically increased not only initially but in the long run. However, if the insurance package is well balanced and if the health manpower exists, then the effect of a national insurance should be to initially increase hospitalization but decrease utilization in the long run.

BED NEED

The measures derived in the last section regarding total patient-days will be repeated here in a summary fashion because they are an integral part of the calculation of bed needs.

(1) Obstetrics:

- (a) 73-89 patient days per 1000 population of all ages- both sexes

(2) Children (0-14 inclusive)

- (a) Prepayment 160-275 patient days per 1000 children age 0-14 inclusive
- (b) "Good" care- 200-325 patient days per 1000 children age 0-14 inclusive.
- (c) "Adequate" care- 300-450 patient days per 1000 children age 0-14 inclusive

(3) Adults- Med-Surg. (15-64 inclusive)

- (a) Prepayment- 460-535 patient days per 1000 population age 15-64 inclusive
- (b) General- 1025-1125 patient days per 1000 population age 15-64 inclusive

(4) Elderly- Med-Surg. (65 and older)

- (a) Prepayment- 2155 patient days per 1000 population age 65 and older
- (b) General- 4200-4400 patient days per 1000 population age 65 and older

While these figures should be the basic figures from which any calculations of bed need are made, a reference point is needed in order to discuss alternative system's designs. For a reference point, the number of beds will be shown per 1000 population of all ages. The basis for adjusting the figures shown will be the 1970 Massachusetts census. The census breakout is as follows:

Age Group	Population(000's)	Percent
0-14	1565	27.6%
15-64	3488	61.2%
65+	636	11.2%
TOTAL	5689	100.00%

The occupancy rate for obstetric beds will be assumed to be 70%. The occupancy rate for pediatric beds will be assumed to be 70%. The occupancy rate for medical surgical beds will be assumed to be 85%. All children age 0-14 will go into pediatric beds.

Beds per 1000 Population

Type	Prepayment	General(Adequate)
Obstetric	.27-.33	.27-.33
Pediatric	.17-.30	.32-.48
Med.-Surg.	1.69-1.84	3.54-3.82
TOTAL	2.13-2.47	4.13-4.63

With this as a reference point, a discussion of the alternative patterns of delivering services, providing education and conducting research,may finally, be undertaken.

ALTERNATIVE SYSTEMS DESIGNS

The information previously presented on size, occupancy rates, variables, accessibility, and utilization is commonly the information which is believed to be most crucial in establishing standards and guidelines. The importance of this information should not be minimized. However, this information has not been presented because of its inherent, interesting properties. This information has been presented primarily to aid decision makers in understanding, to some extent, that part of the health care system which is called acute inpatient care and in more properly considering how that part can be designed to be efficient and effective.

The design of the system must take into account the fact that the acute inpatient hospital (sub) system has four functions: providing medical care, teaching, research, and survival. Thus, the building of the system must take into account the likely effects on each function.

The building blocks of the system have been previously discussed. The hospital bed was considered to be elemental; then the beds were "built up" into eleven types of hospitals:

MS	MS-O	MS-P-O
P	MS-PS	MS-P-PS
PS	P-PS	MS-O-PS
MS-P		MS-P-O-PS

Within these general types, it was further shown that "specialty" could exist along several, general lines - treatment of specialized illnesses and treatment of disease by intensity of specialization required. An example of the first specialization

could be an MS hospital devoted solely to the treatment of cancer patients or an MS hospital devoted solely to the treatment of neurological disorders. Such hospitals are generally called specialty hospitals. The second type of "specialty" that could exist is specialization along the lines of ability to treat. For example, a community hospital might be able to treat heart or stroke patients to some degree, but for more elaborate treatments these patients may have to go to another hospital. Often (and somewhat incorrectly), these distinctions are made by calling the "less specialized" hospital, a community hospital, and the "more specialized" hospital, a referral hospital. More modern terminology describes one type of care as secondary and the other tertiary.

It can properly be assumed that a hospital which provides tertiary care can provide secondary care. It can also be assumed that the specialty hospital provides both secondary and tertiary care for those diseases in which it specializes.

The presentation of various system designs cannot begin until one further point is made. In designing various organizations of hospitals, what is in effect being assumed is that the resource-hospital (or hospital bed, or "building") - is a variable. What must also be recognized is that other resources - manpower, equipment, and dollars - are variables also. This is important to understand, because the distinction among what services a hospital can provide is not so much determined by the building variable but by the "manpower","equipment", and "dollar" variables.

The capability of resources to vary over time have led to the terminology of short-term (or-run), intermediate-term, and long-term variability. In application to the hospital resources of building, equipment, and manpower, it may be stated that "building" is a long-term variable, "equipment" is an intermediate-term variable, and "manpower" short-term variable. The implication of this is that once a hospital building is fixed (built), it is rather hard to move to somewhere else; that once pieces of equipment are located, they cannot be moved readily; but a doctor, nurse, etc., can readily practice inpatient care in any of several locations within a geographical area. (These are generalizations. It is obvious that some pieces of equipment are "more variable" than much of the manpower.)

With these considerations, it becomes readily apparent that if there is no "building" variable within a given community, then no inpatient care will be given within that community. If the broad designations of general (G) and special (S) are given to the manpower and equipment variables where general means "can give only secondary care" and special means "can give both secondary and tertiary care," then the types of inpatient care which can be located within the community are:

Type of Inpatient Care	Variable		
	Building	Equipment	Manpower
1) None	None	-	-
2) General	Exists	G	G-S
3) General	Exists	G	S
4) General	Exists	G	G
5) General	Exists	S	G
6) Special	Exists	S	S
7) Special	Exists	S	G-S

The interpretation of this trivial chart is as follows: if the equipment within a hospital is general and the manpower is a mixture of specialists and generalists (the No. 2 care), then general inpatient care will be given. Basically, the type of care which can be given is determined by a mixture of both the equipment and manpower variable. (Again, it must be stated that this is only a trivial example. For some disease categories, a specialist working with general equipment can offer treatment for all intensities of that disease).

A generalization which can also be made from this chart is that if a community does not have either case No. 6 or No. 7 (General-Special), then there are people who must go outside the community (are referred) to get specialized care.

A further generalization which may be made is that cases 2, 3 and 5 may well be wasteful in their uses of specialized resources (and thus costly).

In cases 2 and 3, there is the possibility that a scarce resource (specially trained manpower) is not being fully utilized because it is constrained by the equipment available. Similarly, in case No. 5 the scarce resource, specialized equipment, is being constrained by the general manpower. Case No. 6 can produce inefficiencies if a patient which is in need of only general care is in that facility. To a lesser extent, this can happen in case No. 7.

In an operational framework, the key to optimal efficiency (by using the conceptual chart) would be to have the specialist doing only specialist work and having the generalist doing general work only in a general resource setting. To take this one step

further, if the need for duplicate facilities and equipment of a specialized sort is caused by the fact that beds, OR's, etc., in such facilities are being occupied by patients requiring general care and not by the fact that the specialized resources have reached their capacity limitations, then there is waste in the system. Or, to interpret this a different way, patients requiring general care should be in, whenever possible, a "building" which has generalized "equipment" and general "manpower".

To tie together the types of hospitals (e.g., O-MS, O-MS-P), the previous information on size, utilization, etc., and intensity of care, three additional terms have to be introduced. These terms are township, local, and regional. These three terms refer to some real geographic areas which, for the purpose of this discussion, are service areas. A township refers to a service area which is a town. Local refers to a service area which is a grouping of several neighboring towns. Region refers to a grouping of several localities.

Theoretically, it is possible that each township could have the total range of inpatient services (MS, O, P, PS) and comprehensiveness of these services (G, S). The same can be true for localities and for regions. If this occurred, the implication is that an individual in a township would have his choice of going to either the town, local, or regional resource for any of his inpatient needs. There is absolutely nothing wrong with this design if all the resource constraints are met. However, it is unlikely that each township can utilize(for example) a 20 bed maternity unit or a 20 bed pediatric unit, or even support a 100 bed medical/surgical facility. It is even less likely that each township can

effectively support a comprehensive burn center, open heart surgery resources, renal dialysis center, organ transplant units, etc.

If all townships can meet the minimal constraints, there may be even better alternatives then inpatient facilities in each township. If several neighboring towns (a locality) are sufficiently accessible to each other, then it may be more economical to build larger facilities which serve a locality rather than several smaller ones which serve individual townships.

Regional resources which provide both general and specialized inpatient care for the regional service area present somewhat of a more difficult problem. If all localities within a region are sufficiently close to each other, then the "collapsing" of hospital resources of localities into larger regional facilities may well be warranted. However, it is generally the situation that localities (and townships) within a region are sufficiently scattered that such collapsing is infeasible.

If no collapsing is possible, there still can exist regional resources for both general and special inpatient care. Here, the difficulty arises (and it may arise at the township or local levels also) when resources (manpower and equipment) become inefficiently utilized because general care consumes specialized resources. In this case, the admittance of any patient requiring general care to a facility offering specialized care could be wasteful (and thus costly).

However, it may well be the case that resources giving both specialized and general care to a regional service area may be cost effective. This may be illustrated by an example. Suppose that a given region has three localities and suppose that the

requirement for tertiary medical care translates into a need for 150 beds. Additionally, suppose that the need for secondary care in each locality translates into a need for 300 beds for the population within each locality. Two of the localities have 250 beds giving general care (secondary) while the third locality has one hospital with 150 beds for tertiary care and 350 beds for secondary care. Further, let it be assumed that the 150 tertiary beds and the 350 secondary beds are in one 500 bed facility. In the region, there is thus a need for 50 more secondary care beds. If the cost to operate these 50 beds (including capital costs amortized) by adding on to the 500 bed facility is $80 per day, while the cost of operating the beds while adding on to either of the 250 bed facilities (assuming each of the other localities has single facilities) is $100 per day, then the regional hospital could be the most cost effective environment. The same type of analysis can be extended to any decision wherein collapsing (or, joining of two or more hospitals together) is feasible.

This process - called collapsing or enfolding - would most probably lead to differing systems designs in different regions. What would most likely occur would be a system which has secondary medical/surgical resources for some townships with the possibility of obstetrics and secondary pediatrics in some of these townships; probably most secondary MS resources, secondary pediatric resources, psychiatric resources, and obstetric resources at the local level; and all tertiary MS and P resources at the regional level. Additionally, the secondary pediatric and medical/surgical resources

as well as psychiatric resources and obstetric resources for the township (or locality) in which the tertiary resources are located would be available within that township (or locality) in which the tertiary resources are located.

If secondary MS and P as well as obstetrics is for a township only, it would seem that the hospital type MS-P-O should exist. An MS separately, a P separately, or an O separately would probably be too small; the process of enfolding should indicate that MS-P-O would be the most desirable combination of the three.

If secondary MS and P as well as O and PS are located at the local level, it would seem that, again, the units would be sufficiently small that the process of enfolding would lead to a MS-P-O-PS. In any event, obstetrics should be located with pediatrics (vice versa does not necessarily hold) so that MS-P-O would be together while MS-PS could conceivably exist along side.

If tertiary MS and P are for the region and secondary MS and P as well as O and PS are for the township (or locality) in which the tertiary resources are located, it would seem that any of the combinations of hospital types could be feasible. It would, however, appear likely that any process of enfolding would result in P, O, or PS each being offered in only one (or a few) facilities.

A specialized hospital - by disease category - would have justification for existing only if the demand for such a hospital was sufficient to allow it to be "free standing". It would appear that any enfolding process would eliminate these types of specialty hospitals because of costliness due to small size.

The pressures - or constraints - which could prevent any logical system from resulting by the process of enfolding are multiple. The institutions would resist giving up services or being asked to merge. Physicians practicing in institutions would oppose change. Consumers would oppose "losing" service. Physicians would oppose division of hospital practices. All these plus how training and research could effect and be effected by the design of this system are still to be considered.

SYSTEM CONSTRAINTS, RECOMMENDATIONS AND CONCLUSIONS

The system that has been discussed has two dominating characteristics:

1) Advocates large, centralized hospital facilities

2) Advocates centralization of specialized services

The constraints on forming this system are primarily with the consumers of health care, the physicians, and those who administer the facilities themselves.

Before discussing how each of these groups may view this system, an important word on costs should be offered. The cost per patient day should be somewhat higher in this system than the costs which exist nowadays. The reason for this is that larger hospitals are capable (and should, to some extent) offer a greater range of services than smaller hospitals. Encouraging three neighboring hospitals of 100 beds each to merge and form one 250-300 bed hospital would, in the long run, result in economies of scale if the service level remained constant. However, it is very likely that a greater breadth (and depth) of services would be offered at a higher cost. For those who may oppose this for the reason of higher costs, two comments should be made. First, a better quality of care is potentially in the offering. Secondly, advancements in medical technology would, if not in the near future, eventually force the consolidation of inpatient resources simply because of the need for specialization. If consolidation is not encouraged now, costs of consolidation may well be greater in the future (even at a net present value).

The first group to consider when advocating this system is that composed of the consumers of health care. While the traditional model of civic pride being manifested by constructing one's own hospital is not as prevalent nowadays as in the past, there is still sufficient community feeling involved with having one's own hospital. Many communities not only feel strongly toward their own hospitals, but often question why their hospitals do not offer more elaborate services than they do. Community demands for coronary care units, supervoltage radiation therapy, pediatric and maternity units are not nonexistent. Most important, nowadays the community hospital is becoming more and more the focal point for ambulatory services. The community can (and legitimately) view the loss of its small hospital as being the first step in total deprivation of health services.

These fears are fairly valid and must be addressed. The most common argument made by hospital representatives of non-referral and non-teaching hospitals in claiming the need for new or expanded facilities under Massachusetts "Certificate of Need" law is that new doctors and more doctors would not come into the community unless the "better" facilities exist. While the distribution of physicians (by numbers and by numbers and age) would tend to validate this, an argument can readily be extended - wouldn't younger physicians be more likely to come into communities A, B, and C if one large hospital rather than several small hospitals existed?

The answer to this question is probably yes; but the counter-argument is that the physicians would tend to populate and practice around the hospital. This too, is very valid; and there are many examples which show that the potential for this is great. Hospitals

are providing more and more space, either physically within or in adjacent buildings, to physicians on their medical staffs. Such behavior can lead not only to less accessible ambulatory care but also lead to total disdain for any type of preventive or even basic primary care.

While there is no clear-cut solution to this problem, it appears that dilemma can be resolved if the whole medical system - including the teaching institutions-begin to encourage ambulatory care. It is not unlikely that clinics could be opened in towns which have no health services. These clinics could act not only to support the primary care needs of the people in the town but can readily (if the population has the demands) sustain manpower other than internists, pediatricians, general and family practitioners. To use the model of India, specialists such as dermatologists, podiatrists, and orthopedists can have days for scheduled visits. Although the clinic setting would probably be the most cost-effective (if the prepaid practices across the United States are an indication), there is no need to assume that solo, partnerships, and group practices would not sustain a centralized system. (Indeed, a township condusive to these practices would probably not need a clinic). However, when operating more independently then in a clinic setting, there could be a greater problem in "getting the providers together" to develop meaningful preventive programs.

In summary, it appears that the encouragement of larger, centralized hospitals would be more condusive an element in encouraging more and younger doctors than having smaller hospitals. Dilemmas which may result from centralizing hospital facilities can be resolved if the consumers and providers would (as they should)

get together to discuss ambulatory needs.

The second group which may express concern over such a system is that composed of the providers of health care. The concerns, while broad, appear to be fivefold:

1) Travel further distances to see their patients in the hospitals
2) Use of the hospital by patients who require diagnostic testing would be more difficult because of travel time
3) Admitting privileges may be restricted
4) Positions previously held (e.g. chief) would have to be surrendered
5) Revenue generating responsibilities may be limited because of restrictions on privileges or responsibilities.

The first point is a wholly legitimate consideration. The more travel-time consumed by the physician, the less time there is available for care rendering. In addition, the further away the physician is, the greater the difficulty in handling an emergency call for one of his patients in the hospital. The best answer to to this is that the doctor's patient would have more resources available for his care-nurses, equipment, etc. - than would be available in smaller institutions. Additionally, adequate care of extreme emergency situations are more often a function of the skill-level of the nurses and the availability of a doctor in the hospital.

The longer travel-time which a person must bear in getting to the hospital for diagnostic testing is also a valid argument. Again, the best response is that there would be a greater breadth of resources available for the services required.

If the medical staff feels that the admitting privileges which were previously allowed should be more restricted, then the physician should have no legitimate complaints. The medical societies have always maintained that only medical professionals should truly judge one another. This same argument pertains to any revenue losses due to restrictions.

The fact that only one person can be chief-of-medicine or chief-of-surgery is a real dilemma. Any individual finds it difficult to surrender a position. However, in merging of institutions, each institution's members should have equal say in any appointments and the awarding of a position should be done with the consent of the medical staff or relevant sub-group.

The last group which would have concerns would be the administrator of the hospitals. If size considerations demand merging of entire hospitals, then all questions related to "preservation of the institution" would arise. These questions pose difficult solutions which should not be slighted. Suffice it to say that problems are enormous but solvable.

Great difficulty would result if services would be encouraged to merge. The merging (and thus loss) of an obstetrics unit would have direct effects on the anesthesists, the hematologists, and the pediatricians. While these problems are great, resolutions should not degrade the overall quality of care given by the institutions.

Another consideration is referral patterns (and admitting patterns). It is often the case that a physician has admitting privileges in hospital X in town A while conducting his practice in town B which has hospital Y. This presents no difficulty if hospital X is a tertiary hospital and all of the doctor's patients from

town B require specialized treatment. However, it is often the case that the patients admitted to hospital X from town B require basic care which can be given at secondary facility Y. Since the system proposed calls for large hospitals even for secondary care, such behavior could tend to cause a maldistribution of resources which should not be encouraged. Dual admitting privileges should be encouraged.

Also, there must be some mechanism to assure that patients from a secondary hospital, when needing specialized care, can gain access to the tertiary institution. While this usually happens through both formal and informal referral mechanisms, any doubt should be eliminated by having formal relationships established among hospitals. In the case of referrals, the referring physician should be allowed consulting privileges on his case.

Having discussed the service function, the next function to consider is the teaching function. The hospital system proposed should not have a detrimental effect on the teaching (education) function as it now exists. The system would probably provide, overall, an even better environment for teaching than now exists. The larger institutions would serve as a broader base for the initial training of students, interns, residents, nurses, etc. The larger secondary institutions should be a better base for both the informal and formal continuing education of the physician.

The only difficulty which may arise would be in eliminating, especially in the tertiary institutions, duplicative services. Teaching hospitals generally find it necessary to have the whole range of services if the student (or intern, etc.) is to get the breadth of education required. While this is sometimes resolved by having several hospitals affiliated with one program

(school), duplication does exist when more than one medical school exists or when related teaching hospitals act independently. This difficulty is real but can be somewhat resolved if the traditional teaching programs were reformed.

(Because reform of the formal teaching system goes beyond the hospital sector, liberty will be taken to go into the ambulatory and extended care sector.) The traditional teaching patterns have emphasized research, specialization, and acute-inpatient care. There is little indication that the traditional system has been encouraging primary care, chronic care, or continuity of care.

To encourage primary care, chronic care, and continuity of care, the formal affiliations must be expanded beyond the acute general hospital to the community hospital, to ambulatory clinics, to chronic disease hospitals, and to extended care facilities. While it is undoubtedly correct that to give good patient care the physician must be capable of diagnosing and treating (to some extent) the whole range of an illness or illnesses, there is no encouragement for the student to ever become interested in preventive and primary care, chronic care, or continuity of care if his entire education is devoted to severe, acute - inpatient care. It is strongly recommended that:

1) Hospitals develop formal associations with (in addition to each other) chronic disease hospitals and extended care facilities
2) Teaching programs within medical schools be reformed to have courses based in not only the acute-inpatient teaching hospital but the community hospital, ambulatory clinics, chronic disease hospitals, and ECF's

3) Internships and residencies be offered in family care and chronic care with a goodly proportion of the program being devoted to the appropriate settings

4) All internship and residency programs require the practice of the specialty being learned in the ambulatory, chronic and ECF setting, (and in the community hospital).

The intent of these recommendations are twofold. First, the training programs must produce manpower which can handle the primary and chronic needs of the population. Second, the physician - regardless of specialty - must be trained in using alternative settings for the care of his patient and must understand that the responsibility for care does not begin and end within the acute inpatient hospital but extends over a continium.

Research is an essential part of medicine. Medical schools must develop doctors who can do patient-related research. However, it appears that there is a severe waste of the scarce resource (the medical school admission) when the medical school turns out M.D.'s who devote their entire time to basic research. The use of other higher education programs should be encouraged for the production of basic researchers. (This may mean sharing of several courses; but this is not a severe constraint).

Research should be encouraged as broadly as possible. Research in both innovative use of hospital resources and treatment of patients should be encouraged. In the latter instance, such research should be conducted only if there is a guarantee that there can be no reasonably foreseen harm to the patient.

Research which is basic and/or apart from the need for the presence of patients should be discouraged from being conducted within the hospital facility. Only when it can be shown that the

housing of such activities is more cost-effective in the hospital facilities than in other facilities should such research be allowed to be conducted within the hospital setting.

The last function - economic survival - is both affected and not affected by the proposed system. The proposed system would encourage the elimination of smaller facilities and smaller service units. However, in the long-run, the proposed system would make survival more certain because of elimination of costly duplication.

The very last point to be made is that the short-term hospital is only one part of the health system and an even smaller part of the human service system. This system should operate to allow the individuals to live to the fullest of their capacity. This particularly means that emphasis must be placed on keeping people well. If, unfortunately, a person should sustain an illness, the health system must react in getting him well in the shortest period of time. If the illness is chronic, the individual should be restored to his fullest capacity. The settings for prevention, treatment, and restoration extend beyond that of the hospital. These settings must be integregated through formal affiliations, and medical practioners must assume responsibilities of treating individuals in all of these settings.

The commonly mentioned statement that "care chases the dollar" can easily be extended to "care chases the dollar and is given in those settings most accessible." If the decision makers wish to emphasize preventive medicine, then preventive services should be financed, ambulatory settings expanded, and other settings constrained. If the decision-maker wishes to emphasize ambulatory

care, then ambulatory services should be financed, ambulatory facilities expanded, and other settings constrained. The same is true for hospitals, long-term care institutions, and home services. The key variables are financing and availability of resources. The "proper" education of the consumer and provider would make the desired effect more readily obtained; but the key variables are physical resources and dollars.

APPENDIX A

Hospital and Service Size

HOSPITAL AND SERVICE SIZE

There have been many arguments made for requiring minimum sizes for hospitals and various service departments. The two predominating arguments are:

1) Ecomomies can be realized by having hospitals or units of larger sizes
2) Quality of care increases as a hospital (or hospital service) handles a greater number of patients.

The first argument is entirely an economic argument. The foundations for this argument lie in basic economic theory. Theorists maintain that, in the long-run, the average cost of producing an item decreases as the number of units increase. The reason why there is an eventual up-turn in the curve (average cost curve begins to increase) is that the demand for a product is limited. The goal of the managers is to predict exactly the demand for the product and the company's market share (percent of demand) and organize his resources so that he can meet the demand for his product using the least-cost mix of resources.

The health planner is concerned with exactly the same problem. The planner attempts to predict the exact demand for health service usage (hospital usage in this paper) and come up with the optimal mix for providing these services. Like the managing executive who has to determine if, to produce 4Q of a product, it costs less to have four plants producing Q than having one plant producing 4Q, the planner has to make determinations on choices of N hospitals of size X or one hospital of size (N)(X).

There are many knowledgeable individuals and organizations that declare that minimum hospital size should be very,very large (200,300, or 400 beds). The regional comprehensive health plan-organizations for the St. Louis, Missouri, has stated that only hospitals of 300 bed minimal size should be built and these must have the potential to expand to 500 beds.[1]

Dr. Anthony J. Rourke, an outspoken medical consultant, has stated that the minimum size of an urban hospital should be 300 beds, and there is no maximum size limit.[2] Ralph Berry, Jr., writing in Health Services Research said that for the best quality of care at the least cost, there should be theoretically one big hospital for the U.S.[3] (of course, as he admits, this is ridiculous).

Each of these opinions are based on the two general tenets that costs go down (returns to scale) and quality goes up as hospital size enlarges. Other people are a bit skeptical of such opinions. Many feel that, like in businesses, diminishing returns do exist and quality can decrease, depending on such variables as organizational design.

Those looking for a perfect answer are, obviously, not going to receive one. There are several considerations which must be taken into account. First, as the size of a hospital grows, there is a tendency to introduce more services into the hospital.[4] The

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1 Hospitals, JAHA, 46:119-20,Jan. 16, 1972

2 Hospitals, JAHA, 113:132, Dec. 69

3 Ralph E. Berry, Jr.,"Returns to Scale in the Production of Hospitals Services,"Health Services Research, Vol 2:123-139, Summer, 1967.

4 See Mary Lee Ingbar and Lester D. Taylor, Hospital Costs: A Case Study of Massachusetts Cambridge, Mass. Harvard Clinic Press 1967.

result of this is that more highly trained people and more sophisticated equipment are required. The average cost, subsequently, goes up and does not go down. Secondly, the geographic dispersion of the population requires the existence of many, "small" hospitals.

Accepting the fact that geographic considerations can validate the existence of "small" hospitals, the weighty evidence of empirical studies does support the fact that hospitals should be of minimally 200-300 beds, and as large as possible were great size can be achieved.

In a study based on over 3000 short-term general hospitals in the U.S. in the year 1963, Carr and Feldstein adjusted for many variables to determine the "optimal" size for a hospital.[5] The first cut, which the authors found to be statistically biased, showed that the optimal size (when services were held at the mean and all other variables were absent) was approximately 190 patients served per day. This was the minimum solution to the second order regression equation (meaning that the cost function is shaped like a shallow cup). The researchers then determined to divide the hospital population into 5 groups distinguished by service capability. The findings were extemely interesting. In each of the service groups, the average cost per patient day decreased as the average daily census (hospital size=average daily census/occupancy rate) increased. Only in the group offering the most services did the

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5 W. John Carr and Paul J.Feldstein, "The Relationship of Cost to Hospital Size" Inquiry Vol. 4:45-65 June, 67.

average cost curve reach a minimum and begin to turn upwards (at about 330 average daily census). The average cost curves for each of the first four groups (the lowest numbered group has the least services, and so forth) lay below each other. And, the average cost curve of the greatest service group, at its optimum, was below that of third service group.

Martin S. Feldstein studied the affects of scale on hospital costs in England.[6] His findings were very similar to those above. In his conclusions, Feldstein wrote:

> "The average cost function, when adjusted for casemix, is a shallow U-shaped curve with a minimum at the current average size (310 beds). Costs rise beyond this size but level off after 600 beds at about 10 per cent above the minimum cost. The failure to achieve economies of scale is primarily due to the lower case-bed ratio in larger hospitals, even after adjusting for casemix differences. ...When costs are adjusted for case-flow rates, cost per case decreases throughout the observed range of hospital size to a value of £ 49.30 at 905 beds, some 12 per cent below average cost. Cost curves for individual input categories show that the pure labour component - ward staff costs - have the greatest diseconomies of scale while direct costs and other indirect costs generally enjoy increasing returns to scale when adjustment is made for case-flow rates.
>
> These results indicate that the medium size hospital of 300 to 500 beds is at least as efficient at providing general ward care as are larger hospitals. But although the medium size hospital must not be rejected as uneconomically small, it cannot be defended as substantially less costly than the larger hospital. If the case-flow rate of larger hospitals could be inproved so that it was not lower than the rate in other hospitals - primarily by decreasing average lengths of stay - operating cost per case in larger hospitals could be reduced to better than 12 per cent below current average cost. Additional savings in capital costs would also be achieved. Further economies could be obtained by larger hospitals if they lowered their expenditure on ward staff into line with the rest of the hospitals."[7]

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6 Martin Feldstein, Economic Analysis for Health Service Efficiency; Markham Publishing Co. Chicago: 1968, Chapt. 3.

7 M. Feldstein, p. 86.

The evidence from the above studies tend to support the conclusion that the minimum size of a hospital in an urban area should be 200-300 beds and that the size should be greater if the population can sustain it.

The effects of services on costs makes relevant another question: Should hospitals, as they grow, be constrained in the services they offer? Operationally, this may be translated into having "community" hospitals which offer basic inpatient services and referral institutions which offer "exotic" care. The answer from the data appears to be yes and no. There should be no such thing as simply a referral (or specialized) hospital which does not offer, in addition, basic care. The reason for this (following the empirical data) is that if the system resulted in a referral hospital of size N and a community hospital of size M, then M+N could be a less costly alternative.[8]

The other part of the answer to the question is that institutions should be constrained in the services they offer. Most specifically, relatively infrequently used services - e.g. open heart, dialysis, respiratory ICU's, even CCU's, organ transplant, radium therapy, ultra-sophisticated diagnostic radiology - should not be duplicated within a given area or region. This implies that all hospitals in a region should plan together and that the introduction of any specialized service should contain documented evidence by the other institutions regarding similar services which they may have, the capacity of those services, the costs of those

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[8] In addition, some individuals have expressed the opinion that a referral center giving just intensive care would be too "nerve wracking" on the medical personnel.

services, and the long-range plans of the institutions for those services.

The approach of encouraging very large hospitals should, in the short-run, adversely effect the costs of delivering (one-day of) hospital care. However, in the long-run, these costs should be stable (in constant dollars) and the quality of care should increase.[9]

For non-urban areas, hospital construction of less than 100 beds should be allowed only when the area is geographically isolated. In both urban and rural settings, when hospital sizes are below the prescribed minimum and other hospitals exist, merger should be encouraged.

Since the limiting of hospitals services is a key issue, it becomes apparent that arrangements among hospitals for referrals must be established. Although there are several mechanisms for doing this and the people should not be denied free choice, it is recommended that:

1) All hospitals enter into working arrangements with each other for the provision of medical services which cannot be offered at one but can be offered at another.
2) For these specialized services, any patient of a physician with privileges at hospital X who requires the services of hospital Y should be admitted to hospital Y under the charge of a doctor at hospital Y with the physician of hospital X being allowed to consult with that physician.

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[9] Quality of care from a medical viewpoint. Patients seem to measure quality of care by how personal the care is. If this were the measure, the quality could decrease.

3) Physicians should be encouraged to admit those patients which do not require specialized services into the hospital closest to that patient's home.
4) If the third consideration implies that the physician must have admitting privileges at two institutions, this should be encouraged.
5) Individuals who seek basic treatment from hospitals outside their service area should have a lower priority for admission than those individuals who require service and reside in that service area.

The same above points should pertain to service departments within hospitals - specifically pediatric departments. A pediatric service should have a minimum size of 20 beds - the minimum size of a nursing unit which appears economically justifiable to have specialization.

If a pediatric service cannot maintain an appropriate occupancy rate at this size or if there exists a pediatric service in a hospital relatively close (20-30 minutes), then the pediatric unit should (in the first instance) be closed and have units of versatile use, and (in the second instance) merger should be encouraged.

A maternity service should have no fewer than 2000 deliveries per year. If geographic isolation requires the existence of a unit which gives fewer births, then it must be allowed. However, the existence of duplicative units within 15-20 minutes each other should not be encouraged.

APPENDIX B

Variables Affecting (Inpatient) Use

VARIABLES EFFECTING HOSPITAL (INPATIENT) USE

The use of hospital beds has received considerable attention in recent years. The dominating interest in studying the use of hospital beds appears to be in finding ways to reduce hospital use because the costs of hospital stays are so great. The "attack" on hospital usage, from a planning viewpoint, basically is an attempt to find ways of maintaining the health status of the population by using less costly alternatives than the hospital bed.

Few people doubt that the cost of hospital services has increased dramatically. The below table gives price indexes for various medical care sectors along with the general consumer price index:

INDEX OF PRICES 1) *

YEAR	CPI ALL ITEMS	TOTAL MEDICAL CARE	PHYSICIANS' FEES	HOSPITAL DAILY SERVICE CHARGES
1950	72.1	53.7	55.2	28.9
1955	80.2	64.8	65.4	41.5
1960	88.7	79.1	77.0	56.3
1965	94.5	89.5	88.3	76.6
1968	104.2	106.1	105.6	113.2
1969	109.8	113.4	112.9	127.9
1970	116.3	120.6	121.4	143.9
1971	121.3	128.4	129.8	160.8

1) 1967 = 100

* Tables 90,565 - Statistical Abstract of the United States, 1972, U.S. Bureau of the Census, Washington, D.C., 1972

The use of the short-term general hospital has varied relatively slightly in the past several years.[2] Thus, it is fairly safe to conclude that the motivating factor behind the widespread interest in use of hospital beds is the cost of that use.

The single most valuable publication to date on usage of health services is a recent publication entitled The Utilization of Health Services: Indices and Correlates.[3] In this publication, the author developed a classification scheme for variables which relate to health service usage and abstracted over 200 recent studies which were involved in studying the effects of variables on usage. The number of variables which have been discussed and studied are enormous. Some of the more relevant variables found to be associated with hospital utilization are listed below:

1) Age
2) Sex
3) Availability of hospital beds
4) Ability to pay - insurance coverage, income, etc.
5) Availability of other health care resources e.g. nursing homes, physicians
6) Organization of services
7) Incentive (or disincentive) payment mechanisms e.g. prepayment, deductibles
8) Utilization review
9) Educational level
10) Health education - including information on sources of care, preventive behaviors
11) Race and ethnicity

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2) Total days in hospital/1000 population for noninstitutional, short stay hospitals exclusive of Federal Hospitals, includes newborn: 1966 - 1203, 1967 - 1215, 1968 - 1214, 1969 - 1211: Table 109, Statistical Abstract of U.S., 1972; Also, data in issues of Hospitals, JAHA, from 1970 on indicate that admissions in New England have been, by month, relatively equal to or less than similar months in previous year; and length of stay has been equal to or less than, by month, the previous years average with only one exception.

12) Price of medical services
13) Occupation

Each of these variables, and several more, have been found to be related to the usage of inpatient hospital services. However several appear to dominate all the others.

Age and sex are the most influential variables on health service utilization. The best examble of age influence on hospital usage can be shown by the behavior of Kaiser Foundation Health Plan members, Northern California, in 1969 calendar year:[4]

ALL MEMBERS

AGE	HOSPITAL DAYS PER 1000 MEMBERS	DISCHARGES/ 1000 MEMBERS	AVERAGE LENGTH OF STAY (DAYS)
0-19	182	41	4.4
20-44	469	99	4.8
45-64	816	95	8.6
65+	2154	196	11.0

By sex and age, this membership had the following behavior:[4]

	MALE			FEMALE		
AGE	HOSP. DAYS[5]	DISCHARGES[5]	L.O.S.	HOSP. DAYS[5]	DISCHARGES[5]	L.O.S.
0-19	193	41	4.7	171	42	4.1
20-44	255	36	7.1	663	156	4.3
45-64	820	89	9.2	811	100	8.1
65+	2442	227	10.7	1856	163	11.4

3) Aday, Lee Ann. The Utilization of Health Services: Indices and Correlates: A Research Bibliography, Purdue University, Department of Sociology, Lafayette, Ind. 1972

4) Sommers, Anne Marshall-ed., The Kaiser Permantente Medical Care Program, New York, The Commonwealth Fund, 1971

5) per 1000 members

The "peculiar" statistical behavior of the female group 20-44 is accounted for by pregnancies.[6] Adjusting the data for this, the female age group of 20-44 would, devoid of cases for delivery, have an average length of stay of roughly 6.3 days and an average admission rate of 40-50.

The availability of beds, in itself, is a very strong factor in influencing the use of hospital beds. This statement may be considered somewhat simple - for it is logical that if no beds exist, then the use rate would be less than if 2 beds per 1000 individuals did exist. However, findings seem to indicate that if 2 beds per 1000 individuals exist, they will all be used - the same holding for 3 per 1000, 4 per 1000, and so on.[7]

The phenomenom of the Kaiser Permanante Plans (1.8 beds per 1000 population[9] as opposed to a U.S. average of 4.2 per 1000 in 1970[10]) is, apparently, due primarily to the "scarcity" of beds. Kaiser officials admit that, even in their program, if their were 2.2 beds available per 1000 members, the beds would be filled.[8]

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6) The average OB stay is 3.3 days and the average admission rate for OB for the group is roughly 100-110

7) In the United States, recent data reported by Hospitals might indicate that this is no longer the case. Utilization rates of hospitals have been severely dropping in the past year.

8) See Sommers op. cit., and Williams, Greer. Kaiser-Permanante Health Plan,- Why It Works, Henry J. Kaiser Foundation, Oakland, Calif. 1971

9) Sommers, op. cit.

10) 1970 - U.S. civilian pop. 202,000,000; short-term beds 848,000 U.S. Statistical Abstract, 1972 - Table 2 and 107

In analyzing the British health system, Feldstein[11] found that the more beds available, the more beds used. In a chapter on supply and use of hsopital in-patient care, Feldstein entitled a section "The insatible demands for bed days and hospital admissions" and said:

> If the current pattern of response to regional differences in availability indicated some level of supply that would satiate demand for bed days, this would at least provide an upper limit to appropriate provision and might indicate the number of beds that it would be desirable to provide if resources for health care were not limited. Unfortunately, there is no evidence that as availability increases bed-day demand tends toward such a limit; on the contrary, the data suggests that, at least within the observed range of supply, bed-day demand increases proportionally with availability 12).

Several findings of Feldstein were very interesting in explaining this phenomenoma. It was found that the elasticity of admissions with respect to bed availability was greater than the elasticity of mean stay with respect to bed availability. In addition, the elasticity was greater for men than women. Feldstein's findings are below:

[13]

ELASTICITY WITH RESPECT TO BED AVAILABILITY

	BEDS USED	ADMISSIONS	MEAN STAY
All persons	.947	.580	.365
Males	1.044	.638	.409
Females	.875	.523	.351

11) Feldstein, Martin S. - Economic Analyses for Health Service Efficeincy; Markham Publishing Co., Chicago 1968

12) Feldstein, ibid, p. 198

13) Feldstein, M., ibid p. 205

The findings of Feldstein support previous work done by Durbin and Antelman[14]. These researchers used 1961 data from each of the states on length of stay, admission rate, beds per 1000 population, physicians per 100,000 population, percentage of population covered by health insurance, and average per capita income. The findings from the sample, based on multiple regression analysis, were that length of stay increases by.20 days for each unit increase in the number of beds per 1000 population and that admission rate per 1000 population increased by 25.30 for each unit increase in the number of beds per 1000 persons.

The "insatible" demand for hospital beds is a real phenomomenom. However, in very recent years, there are many indications that this demand has been somewhat curbed. Initially, the interpretation of the decline in the increase of total patient-days (second derivative effect) was that the prevailing economic conditions were depressing the hospital census. However, the trend of patient-days has been fairly stable in the past few years and other explanations should be given.

A somewhat decent explanation of this phenomenom appears to be that the community - providers and consumers - are reacting to much of the publicity around "lengthy" hospitalizations and "unnecessary" hospitalizations. The government is encouraging ambulatory care and providers are responding by instituting ambulatory services. Most significantly, the direct and indirect effects of utilization review appear to be causing length of stay to decrease and to be depressing admission rates.

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14) Durbin, R.L. and G. Antelman, "A Study of the effects of selected variables on hospital utilization. "Hospital Mangt. 98 (August): 57-60

The effectiveness of utilization review is being studied separately from this report and its companion reports. Some general comments can be made. Utilization review effects hospital demand in two ways: through admission screening and through length of stay validating. The entire process appears to be somewhat ineffective unless several conditions exist:

(1) The availability of beds is constrained for some reason and the medical-staffs must review their cases in order to "make room",

(2) Utilization review is being conducted by an organization other than the medical-staff of the relevant hospital,

(3) Utilization review "standards" are established and outside organizations retroactively review cases for conformance to these standards.

The first condition is best exemplified by the general content of articles in hospital journals concerning small (in general) hospitals who could not afford to expand. These hospitals commonly report that, faced with this pressure, they instituted utilization review of admissions from the emergency ward on daily bases and reviewed the cases of patients within the hospital several times per week. The general effects were a rather severe decrease in admission rates and length of stay.

However, studies in New Jersey appear to show that such effects can be short-lived. When the effectiveness of the utilization review removed the pressure, admission rates and length of stay began climbing until pressure was once again felt. A way of eliminating this occurence is to have an "outsider" as part of the utilization review program. In states which have utilized this approach, initial and sustained effects

have resulted. (A key to this approach is to develop standards which the reviewer uses upon visiting the hospital. The reviewer may grant extensions; however, the frequency of his granting extensions is recorded by the state.)

The last condition mentioned-that of standard setting for use in retroactive review - has many failings. However, an interesting finding in a mid-western state was that when 15 days was set as the time to re-review all cases getting state payment, the near totality of patients were discharged on the fifteenth day. When the state decided to cut the 15 days after admission for re-review to 13 days, the near totality of patients were discharged on the thirteenth day.

The organization of the health care system plays an important part in determining the usage of hospital-inpatient facilities. The most notable difference occurs when a population prepays for its services as opposed to paying a fee for the use of a service upon consumption. In the first instance, the group who is to provide the service has every incentive to "not see anybody," or to keep the people as well as possible. In the latter case, there is no incentive to do anything but cure the individual when he requires care. (From a theoretical view, if the demand is not great, the incentive is actually to keep the person ill so that he requires more care.)

The difference in these types of organizations can be seen by comparing the hospital usage rate of federal employees who chose Blue Cross under their high option to those who chose group practices, prepaid programs:

ANNUAL HOSPITAL DAYS PER 1000 COVERED PERSONS

STATE AND TYPE OF PLAN	RATE PER 1000
D.C., Va. Md.	
Blue Cross	830
Group Practice	430
New York	
Blue Cross	800
Group Practice	570
California	
Blue Cross	715
Group Practice	395
Oregon	
Blue Cross	930
Group Practice	290
Washington	
Blue Cross	760
Group Practice	335
Hawaii	
Blue Cross	1000
Group Practice	515

15), 16)

The organization of the system need not be limited to type of payment. Group Health Insurance - GHI in the New York-New Jersey area is a large group-practice based on fee for service - the fees being pre-negotiated. This practice has shown surprisingly good effect on hospital use rates with the apparent benefit being exacted (after normalizing for other variables) from the continuity of care given and the ability of the physician in choosing the setting for treating the patient without

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15) Federal Employees Health Benefits Program, Jan.- Dec., 1966; Comparing Hospital Utilization among several states for Blue Cross and Group Practice Plans; Non-maternity In-Hospital services, high option

having to worry about payment for services.

The Kaiser plan experimented with an organizational design of incorporating an ECF adjacent to the acute hospital and, also, instituting a home care program. The effect of this was to decrease hospital days for groups both over and under 65 years of age. Unfortunately, the cost differentials were neglible so that Kaiser abandoned the program.[16]

However, various unpublished documents tend to show that hospital stays are increased when there are no alternatives for treating the patients. Significantly, the absence of home health services and nursing home beds cause patients, particularly the elderly, to be kept in the most expensive alternative - the hospital - when the resources of that alternative are no longer warranted.

The availability of physician resources tend to show differing effects on hospital usage. If the physician supply is high as well as the bed availability, then there appears to be a tendency of greater hospitalization.[17] However, if the physicians are organized to give comprehensive services to individuals, the hospitalization rates apparently decrease in the long-run (although initially are greater).[18]

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16) Hurtado, A.B. et al. "The organization and utilization of home-care and extended care facility as a pre-paid comprehensive group practice plan. "Medical Care 7 (Jan.-Feb.)

17) Aday, op. cit, p. 49

18) Alpert, Joel. "Effective use of comprehensive pediatric care." Amer. J. Dis. Child 116 (Nov.): 529-533, and Aday, op. cit, p.47

The "confusion" in determining how physician supply effects hospitalization is probably due to the organization and payment schemes for health services. While it would seem inituitively certain that the more physicians there are the healthier the population would be and thus the fewer hospitalizations, this is not so. The number of physicians do not influence the manner in which the population goes about maintaining itself. The population apparently goes to the physician only when fairly ill. The greater the number of physicians, the easier the access when the person is ill. And, since more people will be seen by physicians, more people will be hospitalized.

If, however, the population would utilize physicians to maintain their health, then there probably would be less hospitalization (everything else constant), especially if the payment scheme rewarded such behavior.

The ability to pay has a definite effect on hospital usage. When ability to pay means that the individual has no risk (financial) in his hospitalization, the use of the hospital increases. In 1970, federal employees insured by Blue Cross, high option had tremendously different characteristics than those insured under the low option:

19)

RATE PER 1000 MEMBERS

	ADMISSIONS	DAYS	AVERAGE LENGTH OF STAY
High Option	134	992	7.40
Low Option	90	580	6.48

19) Pachl, Margith. "The Use of Hospitals by Blue Cross Members in 1970 "Blue Cross Reports No. 8. Dec. 1971

In an exhaustive work on hospital and medical economics in the early sixties[20] which directly influenced the passage of Medicare and Medicaid (this study found that poorer people had less insurance coverage than richer people, and people over 65- being very poor- had little coverage), the researchers found that there was little connection between length of stay and insurance coverage. However, there were positive findings that admission rate and insurance coverage were significantly related. Controlling for income, age, sex, and educational level by multivariate analysis, the study found a large variability in insurance coverage and hospital use. The study found that 10 1/2% of those not covered were hospitalized while 13 1/2% of those covered were. Interestingly, this difference was nearly entirely accounted for by difference in surgery rates (6% to 4% for those covered to those not covered).

The use of hospitals does not appear to be related to a person's educational level in that income level becomes a large intervening variable. The price of hospitalization appears not to have a significant effect on usage nowadays. This is probably due to the third-party coverage.

Very little information is available on health education and prevention and their associations with hospital usage. As previously mentioned, there are indications that comprehensive care will, in the long-run, reduce hospitalization.

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20) McNerney, Walter J. Hospital and Medical Economics

The fact that there are few imperical studies relating health education to hospital usage is somewhat disheartening. Studies over the years in the use of safety belts and shoulder harnesses, testing for TB, PAP tests, incidence of cancer and cigarette smoking, exercise and heart disease reduction, early detection of venereal disease, and alcoholism and its effect on the liver and on driving accidents: all clearly indicate that education and prevention can severely depress hospital usage. Recent studies conducted show that few individuals know the warning signs for cancer and a suprising number of individuals do not know that they have suffered heart attacks. The medical community - as an organized group - has supported most all the preventive and education programs which have been put forth.

However, as individuals, few physicians are interested in preventive medicine or in seeing well-people.[21] The consumers are uninterested in observing proper care. The insurance industry has not stepped forward in its coverage of education and prevention programs. And, the federal government appears to be more reluctant in financing these services.[22] It apparently has been left to state and municipal governments to finance these activities, if they are to be financed.

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21) See Greer Williams, op cit

22) HSMHA OPS Obj. 4 - 1973 FY

APPENDIX C

Occupancy Rate

OCCUPANCY RATE

The "proper" occupancy rate to use in calculating bed need is an important planning function. Occupancy rate converts patient-days into bed needs. A hospital bed is, theoretically, a resource which is available 365 days in a given year. A hospital which has 100 beds has 36500 available bed-days as a resource. The use of these beds - the total patient days - divided by the bed-days available is the expreienced occupancy rate of the hospital.

The hospital administrator is concerned about occupancy rate because the occupancy rate aids him in determining his theoretical "break-even" point - the point where revenues equal costs. The administrator estimates the costs of running his hospital - capital costs, personnel, supplies, etc. - and projects the volume of patients required to make the revenues equal costs.

For the short-run, only a small percentage of hospital costs - supplies such as food, linen, and drugs - are variable. Personnel nurses, maintenance, aides, etc. - are "less" variable because of time delays in hiring, firing, and training. Thus, the administrator is faced with a relatively fixed daily cost in the short-term.

If the administrator sees the costs of running his hospital for a given year as x dollars, then he attempts to adjust the daily charges per patient (call this y) to equal the costs x. Since fluctuations in demand generally negate ever having a 100% occupancy rate, the administrator works from a formula which is (365) (Occupancy Rate) (y) = x. Since the occupancy rate is projected for a given year, the administrator attempts to adjust y to accomplish a break-even situation.

The concern of the planner is to try and make the occupancy rate as high as possible so that y can be as low as possible. In the long-run, the planner realizes that there are many more costs which are variable than in the short-run. In the long-run, x can be divided into fixed costs-x1 - and variable costs - x2. Savings can be realized if the marginal cost of a patient-day is less than the average cost (a fact which is so in the long-run and holds true, to some limits, in the short-run). Thus, the planner is interested in an occupancy rate as high as possible within the hospital system.

The "optimal" occupancy rate is a function of hospital (or departmental) size, length of stay, and the frequency distribution of admissions and length of stay.

One theoretician[1], taking size and daily fluctuations in hospital census into account, has proposed a modification of a previous formula to determine optimal occupancy rate:

$$D = \frac{365N}{N+3\sqrt{N}}$$

D= average number of days a hospital bed is occupied

N= number of beds in the hospital

This formula can be rewritten as follows:

$$D = 365\left(1/1+\frac{3}{\sqrt{N}}\right)$$

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[1] Popov, G.A. Principles of Health Planning in the U.S.S.R., Public Papers No. 43, World Health Organization, Geneva, 1971, p.74.

Since $\sqrt[3]{N}$ decreases as N increases, it readily follows that the occupancy rate increases as N increases. Some results follow:

Number of Beds	Optimal Beds - Occupied	O_a
1000	333	.91
400	317	.86
16	208	.56
9	182	.49

The basic reason for why occupancy rate increases with size can be explained by statistics. If the demand for hospital beds in a given day from locality A is a normal distribution with a mean U and a variance s^2 and the demand for hospital beds from locality B (neighboring town) is a similar distribution, than to assure that 95% of all people who demand a bed will be admitted, each town would have a hospital with U+2s beds (the mean plus 2 standard deviations), or 2(U+2s) = 2U+4s number of beds for both towns. If, however, one hospital served both towns, then only about 2U+2.8s beds would be needed to assure 95% coverage for both towns.[2] (This is because the standard deviation is the square root of the sum of the individual variances.)

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[2] Many people would argue that the demand functions are not independent - that, if full, one hospital would spill-over into another. This author believes this is minimal because the demand for use of a given hospital's inpatient resources is, in the short-run and intermediate run, largely determined by admittance practices of doctors and people's care seeking behavrior.

Length of stay is also important in determining occupancy rate. While it is not necessarily obvious, the occupancy rate should increase as the length of stay increases. A formula developed to include both admission rate and length of stay to determine the number of beds required to guarantee 99.5% admission is:[3]

$$K=PJ\left[1+\left(\frac{3s}{J}\right)\left(\frac{J}{\sqrt{P}}\right)\right]$$

where K= daily number of beds required

P= average length of stay of patients in bed

J= daily number of requrest for admission

s= standard deviation of J

The average daily number of beds needed is PJ. Thus, the occupancy rate (O) would be:

$$O=\left[\frac{1}{1+\frac{3s}{\sqrt{P}}}\right]$$

Thus, as P increases, the denominator decreases and the occupancy rate increases.

This formula does not, however, take into account the frequency distribution of length of stay. Studies of length of stay data[4] clearly indicate that length of stay is a beta distribution skewed to the right (the majority of the cases have a length of stay of five days or less but the remaining "tail-off" to greater numbers of days). This variability in length of stay does create another dimension of"uncertainty"which adversely effects occupancy rate (i.e. prevents 100% occupancy).

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3 Popov, op.cit, p.89.

4 Length of stay in PAS Hospitals. U.S. Regional 1969-71. Commission of Professional and Hospital Activities. Ann Arbor, Mich. 1970-72

The author of this paper has worked several hand-simulations in an attempt to determine what the minimal occupancy rates of the various departmental units should be. The assumptions which were used in these hand simulations follow:

(1) Length of stay will be considered to be a constant for each of the departments

(2) Length of stay for obstetrics will be 4.0, for med/surg will be 8.5; for pediatrics will be 5.0

(3) Sixty-percent of medical/surgical admissions will be non-emergency

(4) Forty-percent of pediatric admissions will be non-emergency

(5) All of obstetrics admissions will be emergency

(6) The daily emergency admissions were considered to be a frequency distribution f represented as follows:
$\tilde{f} = n + \tilde{x}$, where n is a constant and the variable $\tilde{x}$ is uniformly distributed.

(a) $\tilde{x}$ was considered to be uniformly distributed over ranges of 0-10, 0-20, and 0-50.

(b) n was set equal to the difference between the upper bound of the variable $\tilde{x}$ and the number of beds available for emergency (e.g. if a hospital had a 200 bed med/surg. department, 80 beds were considered to be for emergencies - 40%; if $\tilde{x}$ ranged from 0-50, then n was set at 30.)

(7) Medical-surgical and pediatric occupancy rates derived above were multiplied by a crude factor of 14/15 which represents the seasonal adjustments in admissions (AHA statistics for New England basically indicate that half the months are similar while the other half have 13/15 the number of admissions of the other months)

(8) Obstetric occupancy rates were multiplied by 15.5/17.0 for similar reasons.

The results indicate that, until such time as computer simulations can be run, the following are valid, minimal occupancy rates for service (bed) size.

Service Size	Minimal Occupancy Rate
Medical-Surgical	
50-100 beds	75-80%
100-200	80-85%
200+	85-90%
Obstetric	
10-15 beds	50-65%
15-20	60-70%
20-50	65-75%
50+	75-85%
Pediatric	
10-20 beds	60-65%
20-40	65-75%
40-80	70-85%

The variability in admission rate and length of stay is compounded by the fact that the frequency distributions for each of these vary from season to season (month to month) and by day of week. To fully account for all the variability, the author of this paper suggests that demand for beds from a given area be simulated by computer, using a ratio-seasonal equation plus trend to predict admission and using PAS data (see footnote 4) for length of stay distributions. The forecasts arrived by this data can then be used to determine the number of various hospital beds needed, given a hospital size and a rate for "guaranteeing" that 95% or 99.9% of those who require admission will get admission. Unfortunately, the ratio-seasonal plus trend equation is sufficiently complex[5] that it will serve no useful purpose in discussing it here.

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[5] The following equations apply

$$\bar{S}_t = W_e\left(\frac{S_t}{F_{t-L}}\right) + (1-W_e)\left[\bar{S}_{t-1}+A_{t-1}\right]$$

$$\bar{F}_t = W_f\left(\frac{S_t}{\bar{S}_t}\right) + (1-W_e)F_{t-L}$$

$$A_t = W_A(\bar{S}_t-\bar{S}_{t-1}) + (1-W_a)A_{t-1}$$

$$S_{t,T} = (\bar{S}_t+TA_t)\bar{F}_{t-L+T}$$

where $\bar{S}_t$ = smooth estimate of demand/1000 population in period T adjusted seasonally

S_t = actual demand/1000 population in period T

$\bar{F}_t$ = smooth estimate of seasonal factor

A_t = deseasonalized adjusted trend

$S_{t,T}$ = forcast of demand in time t for T periods from now

W_e, W_f, W_a = weighting factors

L = number of time periods in a given year.

It must be emphasized that these results are (1) driven by the assumptions which underlie them (2) preliminary in that the variable $\tilde{f}$ should be described by real-world distributions, (3) minimal, not "optimal", occupancy rates. It should also be noted that length of stay was presumed to be a constant; however, it is believed (although not yet proven) that the variability in the length of stay should not have a significant (but, actually, a weak) effect on occupancy rate, given the size of the unit. The last, and perhaps most important, consideration to note is that the derivation of these occupancy rates assumed a sufficient demand for beds. This section has not attempted to discuss the demand for beds but has been concerned with what the appropriate (or minimal) occupancy rate of a hospital service should be.

APPENDIX D

Determinate of Usage Rates

DETERMINATION OF USAGE RATES

The development of standards for the number of short-term acute inpatient beds required by a population has consistently been one of the most difficult planning tasks. The major reasons for this are: (1) the necessary information to do a thorough analysis of the needs of the population is not available and (2) the availability of other health resources, their organization, and financing systems significantly influence utilization in the hospital sector.

Lack of data has been a critically limiting factor in developing standards. Planners believe that data, minimally, should be available on a patient's age, sex, place of origin, method of payment, diagnosis, service to which admitted, bed in which placed (medical, surgical, pediatric, etc.), and length of stay.

This numerical data is available for the entire population only if all the individual patient-records are readily available for examination. Given the records, however, it is difficult to determine if the admission was necessary and if the length of stay appropriate. Further, there is the added element of people who should receive, but have not received, inpatient services. How many there are is unknown - but the experience of Medicare and Medicaid and indications from controlled studies[1] suggest that there is a "backlog."

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[1] Joel Alpert, "Effective Uses of Comprehensive Pediatric Care." Amer. J. Dis. Child 116 (November: pages 539-533).

The organization and the availability of resources are obvious factors which determine the need for inpatient services. However, this fact is commonly ignored. As a leading health planner in the Soviet Union stated:

> "A common fault in the preparation of standards for the requirements for medical care is to study the various forms of such care in isolation, e.g. to study hospital care without taking into account the fact that different forms of out-patient care are also available. Standards obtained in this way are unsuitable for use in health planning."[2]

The U.S. Government, in attempting to implement the Hill-Burton Act, had several commissions investigate the activities of hospitals in the U.S. and establish standards for hospital beds required. In 1962, the standards, originally developed in 1946, were amended. As far as general hospitals were concerned, the number of beds had to satisfy the following requirements:[3]

Population density of State (persons per square mile)	Number of beds per 1,000 Population
More than 12	2.5 - 4.5
6 -12	3 - 5
Less than 6	3.5 - 5.5

Being ever susceptible to revision, the Federal Government revised the Hill-Burton "standards" by substituting a formula for compilation of bed need. This formula is, basically:

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2 G. A. Popov, Principles of Health Planning in the U.S.S.R., World Health Organization, Geneva, 1971, pp. 131-2.

3 Popov, ibid, p. 143.

$$\frac{TPD_o}{CP_o} \times \frac{ECP_5}{.85} \times \frac{1}{365} = BEDS_5$$

where:

TPD_o = Total patient days in region in current year

CP_o = Civilian population in region in current year

ECP_5 = Estimated civilian population in five years

.85 = Average occupancy rate

365 = Days in a year

$BEDS_5$ = Beds needed in five years in region

This formula has many advantages over the previous "set standards." From a managerially viewpoint, it makes sense to relate future estimates of demand to historical demand. This formula incorporates this by the $\frac{TPD}{CPo}_o \times ECP_5$ factor. It also makes good sense to require some "relative" efficiency standard in the prediction. This is done by using an occupancy rate of 85%.

However, this formula has several disadvantages. First, the total patient days used are not the days used by the civilian population within the area (or region) but the days of service consumed within the hospitals of the area (or region) by people regardless of origin. The use of this measure could cause improper distributions of facilities by reinforcing the existence of institutions which are used only because facilities in other areas do not exist and "cannot be funded" to exist. Second, the formula is a static formula which does not take into account any trends in the usage of hospital facilities. If there is an increasing use of hospital facilities, the formula would tend to understate the demand. If there is a decreasing trend, the formula would overstate the demand. Third, the formula does not segregate the types of services demanded (i.e.

maternity, pediatric, medical-surgical, psychiatric). Because different services can be expected to have different occupancy rates and effect different population groups, segregation by services seems logical when projecting need. Last, the formula, by being based on data from the current health care system, implicitly assumes that the future system (and its usage characteristics) should resemble the current system. If it is accepted that the current system is not only the proper base but also has correct emphasis, then the projection of measures of the current system into the future are valid. However, there is concern that the emphasis of the current system, if not the system itself, is not proper and that, consequently, resources are inappropriately allocated. If this is correct, then the projection of measures of the current system into the future would be inappropriate.

Proper methodology would dictate that projections of future behavior be based on some "historical" data. However, because of the imperfections of the historical system, any such projections should be viewed with caution. In attempting to develop "bed needs", it must be realized that several variables dominate the use of inpatient beds:

1. Age
2. Sex
3. Ability to pay (for any health service)
4. Availability of beds
5. Structure of and relationships among the components of the health system (e.g. education, ambulatory care, preventive testing, nursing homes, hospitals, etc.)

Taking these variables into account, rough estimations of usage rates can be developed from the historical data of selected samples. From usage rates, regional "bed needs" may be developed by applying the rates to the population composition and using the appropriate occupancy rate.

In developing usage rates, several general assumptions will be made. The first assumption is that ability to pay will be eliminated as a constraining variable. This will be done by using as bases population groups whose usage of services is not restricted by the lack of ability to pay (e.g. individuals in prepaid groups and individuals with Blue Cross coverage). The second assumption is that the rates will reflect the long-run usage of services after ability to pay has been eliminated as a constraining variable. That is, the usage rates will not reflect any increased demand for services at the point in time when ability to pay is no longer an inhibiting factor but will reflect the usage rate of a population which has not been restrained by the lack of ability to pay.

While availability of beds and organizational models will not be considered in detail, some effects of these variables will be shown. Usage rates will be developed for two types of population - one under a prepayment system, the other under a fee-for-service system. Effects of availability of beds and usage will be appended to, but not included with, the discussion on the development of usage rates.

The first estimate is for the use of inpatient obstetrical services - the OB bed. Obstetric beds are primarily used for women who are about to give birth or have just given birth. In addition,

obstetric beds may be used for complications of pregnancy and for some gynecologic patients. Analyzing data submitted by hospitals to the Massachusetts Department of Public Health for the year ending September, 1970[4] and to the Greater Boston Hospital Association for the years ending September 1968-71[5], the ratio of obstetric admissions to live-births falls in the range of 1.05-1.15/1.00. If this crude ratio was applied to an estimate of future birth rates, the usage of obstetric beds could be fairly well estimated.

Future estimates of birth ratio can be developed from historical rates. In Massachusetts as well as in the United States, the live-birth rate has been decreasing. The crude birth-rates (live births per 1,000 population) in the U.S. since 1963 are below:

Year	Crude Birth Rate[6]
1963	21.7
1964	21.0
1965	19.4
1966	18.4
1967	17.8
1968	17.5
1969	17.7
1970	18.2
1971	17.3

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4 "Annual Hospital Statistical Report," Massachusetts Department of Public Health - Unpublished data.

5 "Patient Accommodation and Service Data," Greater Boston Hospital Association, Boston, Massachusetts

6 Vital Statistics Report, Annual Summaries for the United States 1969-71, Public Health Service

For Massachusetts, the rate has been similarly declining. From 1968 to 1971, the respective rates were: 17,2, 18.2, 16.9, and 15.7.

The most recently published data indicate that the U.S. birth rate may be below 16.0 for 1972.[7] The data for the first ten months of 1972 indicated a birth rate of 15.6 for the United States. Births during the first ten months in 1972 in Massachusetts were 66,959, which was below the previous year's ten month total of 76,087. Since the number of births in the last two months of the year has historically been below the yearly average, it is probable that the total number of births in Massachusetts in 1972 will be between 80,000 and 81,000, or 10,000 less than the 1971 total. This would translate into a birth rate of approximately 14.0 per 1,000 population.

Using the trend of the past few years, it would appear that the birth rate in future years would range from 14.0-15.0. However, this is a crude birth rate which emplicitly assumes that the proportion of women of child-bearing age(15-44 years) would remain constant. According to recent population projections, this implicit assumption is incorrect. The projections indicate that the percentate of females whose age is 15-44 will increase from 39.0% in 1970 to 45.2% in 1985.[8] The increase in the percentage of

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7 Monthly Vital Statistics Report, U.S. Public Health Service, Vol.21, No. 10, Dec. 26, 1972

8 The percentages given are percent of female population. The projections were developed for the Office of Planning and Program Coordination, Executive Office of Administration and Finance, Boston, Mass.

fertile women within the population requires the crude birth rate to be adjusted. The crude brith-rate of 14.0-15.0 when adjusted by the increased percentage would yield a crude rate of 16.0-17.0 (i.e. approximately 9/8 of the former rates). Since there is much speculation that current birth rates are reflecting (1) a recessive economic condition and (2) the desire of women to postpone pregnancy to later ages, the crude birth-rate of 16.0 to 17.0 in itself may be low. To be extremely conservative, this 16.0-17.0 range will be arbirarily altered to a higher range which will be considered to be the maximum upper limit of the crude birth rate for projections. This new range, 17.5-18.5, reflects the rate in Massachusetts prior to the beginning of the "economic recession" with adjustment made for the change in percentage of fertile women.

The length of stay in an obstetric bed is currently 4.2 days. The length of stay in obstetric beds has been steadily dropping and should easily reach 4.0 days. This length of stay figure reflects the use of obstetric beds for both maternity cases and for some gynecologic cases. Thus, the applicable maximum range for length of stay would be 4.0-4.2 days.

Lastly, the relationship of the usage of hospital obstetric beds to the number of live births has been shown to have a ratio of approximately 1.05-1.15/1.00. Using this adjustment figure and multiplying the crude birth rate of 17.5-18.5 by 4.0-4.2 days, the maximum total of obstetric bed days would range from 73-89 days per 1,000 total population.

The utilization determinants (length of stay and admission rate) for pediatric beds are much more difficult to obtain for three

reasons: (1) there is not universal agreement on the age limit of an admission to a pediatric bed; (2) many children get admitted to medical-surgical beds even if they fall within the pediatric age range; (3) it is not clear that all children who require inpatient care are obtaining that care.

The statistics of the Kaiser program indicate that individuals under 15 years of age have 38 discharges per 1,000 people of that age.[9] Kaiser planners have maintained that the utilization characteristics of their membership have not changed and, consequently, plan for future facilities by rigidly adhering to the historical utilization data. That is, Kaiser planners expect the utilization measures of 38 discharges and 153 patient days of care per 1,000 people 0-14 inclusive to hold in future years.

Statistics from the H.I.P. program in New York indicate that for the age group under 15 the admissions per 1,000 people were 49.6 and the total hospital days per 1,000 people were 277.[10] Although these figures are for 1967, H.I.P. researchers maintain that there is no noticeable change in utilization characteristics over the years. The researchers cite that in 1955 City employees and their dependents enrolled in H. I. P. and below the age of 65, had a non-obstetric admission rate of 59.1 per 1,000 persons

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9 The Kaiser-Permanente Medical Care Program, New York, The Commonwealth Fund, 1971, Appendix, Northern California.

10 H.I.P. Statistical Report, 1970 Enrollment and Utilization Statistics, 1971 Research Project Results, Health Insurance Plan of Greater New York, New York, N.Y. p. 7.

and that in 1967 the admission rate for the same population was 60.8.[11] Like Kaiser, H.I.P. figures appear to be relatively constant over time.

The best estimate of utilization characteristics of the general pediatric population under non-prepaid schemes must be inferred from individual studies. One of the better studies was conducted by Dr. Joel Alpert while working at the Children's Hospital in Boston.[12]

In Dr. Alpert's study, families which had been frequent users of the emergency room were divided into two groups: one group was given comprehensive care while the other group (control) acted as they had in the past. The use of physician services and hospitalization was recorded over six month intervals. The resulting hospitalization figures are below:

TIME PERIOD (MONTHS)	HOSPITALIZATION RATE PER 100 CHILDREN	
	Experimental Group	Control Group
6	**4.26**	2.04
12	2.97	3.74
18	1.82	3.27
24	1.93	3.64
30	3.08	3.87

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11 Ibid.

12 "Effective use of comprehensive pediatric care." Joel Alpert, Amer. J. Dis. Child 116 (Nov): 529-533.

The study suggested that the initial, high utilization rate of the experimental group was caused by a back-log of undiscovered illnesses which required hospitalization. No explanation was given for the sharp rise in the fifth period.

From the data, it may be inferred that if a group of children receive comprehensive pediatric care, then they would require roughly 2.0-3.0 admissions per 100 every half-year. This would be 40 to 60 admissions per 1,000 for a full year. Using the mean length of stay figures from PAS hospitals[13] of 4.5-5.5 days, this would translate into roughly 200-325 days of patient-care per year. (Figures for length of stay in New England in general are considerably higher than for the Western states. If Massachusetts "behaved" like the Western states, then the average length of stay would vary for the 0-14 group from 3.5-4.5 and total patient days would range from roughly 150-250 for Dr. Alpert's experimental group)

If it is assumed that the control group in Dr. Alpert's study was receiving good care (i.e. upon the discovery of an illness, the families had access to and did go to a health facility) and the care-seeking behavior of this group was representative of the Massachusetts population, then the Massachusetts children age 0-14 would be expected to require 60-80 admissions per year and consume 300-450 days of care per year.

Not too surprisingly, statistics for the United States for the age group 0-14 are quite consistent with the control group of Dr.

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13 Length of Stay in PAS Hospitals, United States, Regional 1971, Commission on Professional and Hospital Activities, Ann Arbor, Mich., 1072.

Alpert's study. These figures indicate that in Massachusetts the age group 0-14 would have 67 admissions to short-term hospitals and utilize 340 days of care per 1,000 members.[14]

Medical-surgical utilization has all the difficulties which are inherent to any general display of pediatric statistics - particularly, ability to pay, care not being received, and availability of beds are significant variables effecting utilization. To give some indication of what the utilization characteristics would be if the ability to pay was, to some extent, dampened, the utilization characteristics associated with members in Blue Cross plans will be used as will those of members of the H.I.P. and Kaiser prepaid groups.

The Kaiser and H.I.P. plan members have the following utilization characteristics for the age groups indicated:

Age Group	Admission Rate Per 1,000 people		Patient Days per 1,000 people	
	Kaiser[15]	HIP[16]	Kaiser[15]	HIP[16]
15-44	91	84	429	520
45-64	95	77	816	862
65+	196	--	2154	---

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14 Usage rates for age groups under 1 year, from 1-4, and from 5-14 were obtained from Table No. 109 of the Statistical Abstract of the United States, 1972. These utilization rates were adjusted by weighing the 3 groups in accordance to their numbers in Massachusetts to give the utilization rates fro the 0-14 groups.

15 Sommers, op.cit., appendix.

16 HIP, op.cit.

These figures contain maternity cases. If maternity cases were not included, it is estimated that the following utilization rates would have existed:

Age Group	Admission Rate Per 1,000 people		Patient Days Per 1,000 people	
	Kaiser	HIP	Kaiser	HIP
15-44	47	45	284	365
45-64	95	77	816	862
65+	196	--	2154	---

Collapsing the first two age groups into one by using the age characteristics of the Massachusetts population results in the following:

Age Group	Admission Rate Per 1,000 people		Patient Days Per 1,000 people	
	Kaiser	HIP	Kaiser	HIP
15-64	63	56	460	534
65+	196	--	2154	---
All ages over 15	81	--	700	---

The Blue Cross summary of statistics for the year 1970 is listed below for five groups: (1) All Blue Cross regular members, excluding complementary coverage to Medicare and Federal Employees and Dependents (FED); (2) Individual contracts of Blue Cross regular subscribers; (3) New England regular subscribers; (4) FED

subscribers; and (5) Complimentary Medicare.

Blue Cross Group	Admissions per 1,000 members	Total Patient Days
1. All Regular[17]	128	913
2. All Individual Regular[18]	139	1127
3. All Regular New England[19]	125	867
4 FED[20]	129	945
5. Complementary Medicare[21]	275	----

The first, third, and fourth groups include individuals of all ages, with and without families, and does include maternity cases in the statistics. The second group - individual membership- probably excludes children and probably does not include maternity. The Complementary Medicare is for the group of 65 and older.

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17 "The Use of Hospitals by Blue Cross Members in 1970, Margith Pachi, Blue Cross Reports, Research Series 8, 1971, p.3.

18 Ibid. p. 5.

19 Ibid. p. 8.

20 Ibid. p. 9.

21 Ibid.

To attempt to get a rough estimate of what the regular membership groups would be if maternity and pediatric utilization were eliminated, the following assumptions are made:

1. Since maternity coverage is optional, the Blue Cross members would have a birth rate per 1,000 members of approximately ½ the U.S. rate of 19 which existed in 1970.

2. The average length of maternity stays was 4.0 days.

3. The age distribution of the population enrolled in regular Blue Cross plans was similar to that of the U.S. Since regular membership plans exclude complementary coverage to Medicare, it is further assumed that all of the Blue Cross subscribers are 64 years or younger. Thus, 1/3 of the Blue Cross members are below 15 years of age.

4. The admission rate of this group (0-14 years) is 70 per 1,000 and the total patient-days are 375 per 1,000.

Then, adjusting the regular membership statistics to eliminate maternity cases and "pediatric" cases, the following figures are derived:

BLUE CROSS GROUP	ADMISSIONS PER 1,000 MEMBERS	HOSPITAL DAYS PER 1,000 MEMBERS
All Regular	142	1122
Regular - New England	138	1032

Statistics for the United States, in general, as gathered for the year of 1969 by the Public Health Service, were as follows:[22]

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22 U.S. Statistical Abstract, op. cit., Table 109.

Age Group	Admissions per 1,000 people	Patient Days per 1,000 people
15-44	156 (113)	912 (740)
45-64	163	1625

In parenthesis are the adjustments made to exclude maternity admissions (i.e. the fertility rate was approximately 86, and one-half of the 15-44 population was female. Additionally, average length of stay was 4.0 days). Collapsing the two groups into one results in an admission rate of 140 and total patient days of 1025 per 1,000 people age 15-64.

The similarity of the national figures to the Blue Cross figures is quite surprising. Less surprising, but quite interesting, is the fact that the adjusted figures for regular members were quite similar to the figures for members with individual contracts. From these statistics, it appears that an admission rate of 140 and total patient days of 1025-1125 per 1,000 members would describe the age group of 15-64.

The Blue Cross figure of 275 admissions per 1,000 people under under complementary Medicare is below the U.S. average of 305[23] for that group. Since the third-party payment scheme for those over 65

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23 Ibid.

is so arranged to eliminate ability to pay as a constraint on usage, it would appear that the population of 65 and older consumes 4200-4400[24] days of care per year under non-prepayment schemes.

Two variables of importance haven't been directly introduced into the calculations. One is organizational design of health care system and the other is availability of beds. In the appendix on effects of variables, it was shown that members of prepaid groups had significantly lower hospital utilization. In the case of groups which owned their own hospitals and consciously limited the number of beds available, the availability of beds would appear as a constraining variable. However, several prepaid groups are not constrained by availability of beds but, more importantly, by their budgets. Since the quality of care offered by these groups has been judged over the years to be quite good, it would appear that when there is an incentive to keep people out of the hospital, hospitalization is reduced without affecting the health status of the population.

In addition to having an organizational design which makes it financially rewarding to not hospitalize patients, studies such as Dr. Alpert's show that a system giving comprehensive ambulatory care can reduce inpatient usage. Since the cost of a hospital stay (excluding physician and special charges) is now approximately $80-$100, it would appear logical that increased expenditure in the ambulatory care sector could easily be justifiable if even a

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24 Ibid. (average length of stay being roughly 14 days)

minimal "dent" is made in the hospital utilization figures.

The last, and most important variable, is availability of beds. In the appendix on the efforts of variables, studies were cited which clearly proved that hospital usage was a function of beds available. In another research project performed within the Office of Comprehensive Health Planning in connection with utilization review, hospital usage rates across the United States were analyzed. Consistently, it was shown that there exists a significant relationship between total patient days in hospitals and the number of beds available. Additionally, there was no indication that the health status of the population was higher because of more hospital beds or, inversely, lower because of fewer beds.

An inference which can be drawn from this study is that, if the providers of health care could be properly educated, then the Massachusetts population could be just as healthy with as much as 40% fewer beds in which to receive inpatient care.